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MODEL 7004A
DIGITAL MULTIMETE
SERIAL NO.
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SYSTRON DONNER

Concord Instrument Division

INSTRUCTION MANUAL

MODEL 7004A
DIGITAL MULTIMETER
SERIAL NO.

Ⓐ

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SYSTRON DONNER CORPORATION

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SYSTRON DONNER
CORPORATION

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TABLE OF CONTENTS

		Page
CHAPTER 1 - GENERAL INFORMATION		
1.1	Introduction	1-1
1.2	Specifications	1-1
1.3	Optional Features	1-5
CHAPTER 2 - INSTALLATION		
2.1	Introduction	2-1
2.2	Receiving Inspection	2-1
2.3	Reshipment	2-1
2.4	Power Requirements	2-2
2.5	Acceptance Test Procedure	2-2
CHAPTER 3 - OPERATION		
3.1	Introduction	3-1
3.2	Controls, Connectors and Indicators	3-1
3.2.1	Front Panel	3-1
3.2.2	Rear Panel	3-3
3.3	Operating Procedures	3-5
3.3.1	Sample Rate and Hold Control	3-6
3.3.2	Guard Terminal	3-6
3.3.3	Overload Protection	3-6
3.3.4	mV Zero Adjustment	3-7
CHAPTER 4 - MAINTENANCE		
4.1	Introduction	4-1
4.2	Factory Service	4-1
4.3	Routine Maintenance	4-1
4.4	Printed-Circuit Board Repair	4-2
4.5	Test Equipment	4-3
4.6	Calibration Procedures	4-3
4.6.1	Power Supply Voltages	4-4
4.6.2	Calibration	4-4
CHAPTER 5 - THEORY OF OPERATION		
5.1	Introduction	5-1
5.2	Dual-Slope Integration	5-1
5.3	A1, Count Chain & Readout	5-2
5.4	A2, Switch Board	5-3
5.4.1	DC Amplifier/DC Current	5-3
5.4.2	AC to DC Converter	5-4
5.4.3	Ohms Circuit	5-5
5.4.4	Analog to Digital Converter	5-6
5.4.5	Power Supply	5-6

TABLE OF CONTENTS (Cont'd)

		Page
CHAPTER 6 - PARTS LISTS		
37190-7-1	7004A Final Assembly	6-1
37215-4-1	A1, Count Chain & Readout P.C. Assembly	6-2
37217-4-1	A2, Switch P.C. Assembly	6-5
CHAPTER 7 - DRAWINGS		
37190-7-1	Model 7004A Block Diagram	7-1
37197-4-1	Model 7004A Test Assembly	7-2
37198-4-1	Model 7004A Front Panel Assembly .	7-3
37211-4-1	Model 7004A Rear Panel Assembly . .	7-4
37190-4-1	Model 7004A Final Assembly.	7-5
37215-4-1	A1, Count Chain & Readout P.C. Assembly	7-6
37215-7-1	A1, Count Chain & Readout Schematic	7-7
37217-4-1	A2, Switch P.C. Assembly	7-8
37217-7-1	A2, Switch Board Schematic (Sheet 1 of 2)	7-9
37217-7-1	A2, Switch Board Schematic (Sheet 2 of 2)	7-10
CHAPTER 8 - OPTIONS AND ACCESSORIES		
8.1	Introduction	8-1
8.2	Option 05, Digital Outputs	8-1
8.3	Option 09, Battery Pack	8-3
8.3.1	DC to AC Inverter	8-3
8.3.2	Automatic Battery Charger	8-4
8.4	Accessories	8-5
8.4.1	Input Test Leads	8-5
8.4.2	Single Rack Mount Kit	8-5
8.4.3	Dual Rack Mount Kit	8-5
8.4.4	Front Panel Snap Cover	8-5
37218-4-1	05 Option BCD Assembly Parts List .	8-6
37469-4-1	09 Option Battery Pack P.C. Board Parts List	8-7
37219-4-1	09 Option Battery Pack Assembly Parts List	8-9
37232-4-1	Accessory, Input Test Leads Parts List	8-10
45410	Accessory, Single Rack Mount Kit Parts List	8-11
37492-4-1	Accessory, Dual Rack Mount Kit Parts List	8-12
37229-4-1	Accessory, Front Panel Snap Cover Parts List	8-13
37218-4-1	Option 05, BCD Assembly	8-14
37218-7-1	Option 05, BCD Schematic	8-15

Page

CHAPTER 8 - OPTIONS AND ACCESSORIES (Cont'd)

37469-4-1	Option 09, A3, Battery Pack P.C. Assembly	8-16
37469-7-1	Option 09, A3, Battery Pack Schematic	8-17
37219-4-1	Option 09, Battery Pack Assembly .	8-18
37232-4-1	Accessory, Input Test Leads Assembly	8-19
45410	Accessory, Single Rack Mount Assembly	8-20
37492-4-1	Accessory, Dual Rack Mount Assembly	8-21
37229-4-1	Accessory, Front Panel Snap Cover Assembly	8-22

LIST OF FIGURES

Figure 3.1	Front Panel, Model 7004A	3-2
3.2	Rear Panel, Model 7004A	3-2
3.3	Mounting The A1 Readout Board For Access to A1 Readout Board and Bottom of A2 Switch Board	3-8
4.1	Location, Calibration Controls	4-5
4.2	Typical Temp. Comp. Graph	4-7
8.1	Battery Pack, Installed View	8-9
8.2	Input Test Leads	8-10
8.3	Single Rack Mount Kit	8-11
8.4	Front and Rear Panel Snap Cover	8-13

LIST OF TABLES

Table 2.1	Acceptance Test Procedure	2-3
3.1	Front Panel Functions	3-1
3.2	Rear Panel Functions	3-4
3.3	Operating Procedures	3-6
4.1	Test Equipment for Model 7004A	4-3
4.2	Power Supply Voltages	4-4
4.3	Resistance Calibration	4-8
4.4	DC Voltage Calibration	4-9
4.5	DC Current Calibration	4-10
4.6	AC Current Calibration	4-11
8.1	BCD Pin Assignments	8-1

CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

The SD Model 7004A Digital Multimeter is a full four-digit precision instrument. It offers the five selectable functions of dc voltage, dc current, ac voltage, ac current and resistance. The instrument utilizes an advanced Dual-Slope Integration design with an extremely low-noise input amplifier and a fully guarded, isolated input circuit. These features combine to provide high accuracy and stability, plus exceptional immunity to the effects of both common mode and normal mode noise.

All function and range selection is made from front-panel push-button controls. The readout features a nonblinking display of four full digits plus overrange, auto-positioned decimal point, and an indicator for off-scale readings. Polarity indication for dc voltage and current is automatic with a minus indicator display.

Model 7004A is light-weight and completely portable. It consumes less than 8 watts while operating at line frequencies from 48 to 440 Hz and at voltages of 115/230 V or 100/200 V. The Multimeter may be fitted with an optional built-in battery pack with no increase in size. Optional DTL/TTL compatible digital outputs can also be included for remote printout, digital limit comparison, or other automatic data system requirements.

1.2 SPECIFICATIONS

DC VOLTS

Range:	±.10000 V, ±1.0000 V, ±10.000 V, ±100.00 V, ±1000.0 V.
Resolution:	±10 µV to ±0.1 V in decade steps depending on range.
Overrange:	30% on all ranges except on 1000 V range. Maximum readings are ±.13000 V, ±1.3000 V, ±13.000 V, ±130.00 V and ±1000.0 V at full accuracy.
Polarity Selection:	Automatic with minus indicator.
Input Impedance:	>1000 MΩ on 0.1 V, 1 V, and 10 V ranges. 10 MΩ on 100 V and 1000 V ranges.

DC VOLTS (Cont'd)

Accuracy:	All ranges except 0.1 V range (25±5°C); ±0.01% rdg. ±0.01% f.s. for 1 month. ±0.02% rdg. ±0.01% f.s. for 3 months. 0.1 V range (25±1°C); ±0.02% rdg. ±0.02% f.s. for 1 month.
Temperature Stability (0°C to 50°C):	All ranges except 0.1 V range; ±0.001% rdg. ±0.001% f.s./°C. 0.1 V range; ±0.005% rdg. ±0.01% f.s./°C.
Full-Scale Step Response:	1 second to rated accuracy.
Normal Mode Noise Rejection:	>60 dB at 60 Hz.
Common Mode Noise Rejection:	>120 dB at dc; >100 dB from 49 Hz to 1 kHz with 1 kΩ source unbalance.
Maximum Input:	±1000 V on any range without damage.

DC CURRENT

Ranges:	±.10000 mA, ±1.0000 mA, ±10.000 mA, ±100.00 mA, ±1000.0 mA.
Resolution:	±10 nA to ±0.1 mA in decade steps depending on range.
Overrange:	30% on all ranges. Maximum readings are ±.13000 mA, ±1.3000 mA, ±13.000 mA, ±130.00 mA and ±1300.0 mA at full accuracy.
Polarity Selection:	Automatic with minus indicator.
Configuration:	Shunts, internal to instrument.
Accuracy:	All ranges except 0.1 mA range (25±5°C); ±0.1% rdg. ±0.01% f.s. for 3 months. 0.1 mA range (25±1°C); ±0.1% rdg. ±0.04% f.s. for 3 months.
Temperature Stability (0°C to 50°C):	±0.005% rdg. ±0.002% f.s./°C. 1, 10, 1000 mA ranges. ±0.005 rdg. ±0.01% f.s./°C. 0.1 mA range.
Full Scale Step Response:	1 second to rated accuracy.
Normal Mode Noise Rejection:	>60 dB at 60 Hz.

DC CURRENT (Cont'd)

Common Mode Noise Rejection:	>120 dB at dc; >100 dB from 49 Hz to 1 kHz with 1 kΩ source unbalance.
Maximum Input:	100% above range selected without damage. Input fused at 1.5 A.

AC VOLTS

Ranges (rms value):	.10000 V, 1.0000 V, 10.000 V, 100.00 V, 1000.0 V.
Resolution:	10 μV to 0.1 V in decade steps depending on range.
Overrange:	30% on all ranges except 1000 V range. Maximum readings are .13000 V, 1.3000 V, 13.000 V, 130.00 V, and 500.00 V.
Input Impedence:	1 MΩ shunted by 100 pF.
Accuracy (50 Hz to 20 kHz, except 1000 V range is 50 Hz to 10 kHz.)	All ranges except 0.1 V range (25±5°C): ±0.2% rdg. ±0.02% f.s. for 3 months. 0.1 V range (25±1°C): ±0.5% rdg. ±0.2% f.s. for 3 months.
Extended Frequency Response:	0.1, 1, 10, and 100 V ranges may be used to 100 kHz with ±2% typical accuracy.
Full-Scale Step Response:	3 seconds to rated accuracy.
Maximum Input:	500 V rms on 10 V, 100 V, and 1000 V ranges. 150 V rms on 0.1 V and 1 V ranges without damage.

AC CURRENT

Ranges:	.10000 mA, 1.0000 mA, 10.000 mA, 100.00 mA, 1000.0 mA.
Resolution:	10 nA to 0.1 mA in decade steps depending on range.
Overrange:	30% on all ranges. Maximum readings are .13000 mA, 1.3000 mA, 13.000 mA 130.00 mA, and 1300.0 mA.
Configuration:	Shunts internal to instrument.

AC CURRENT (Cont'd)

Accuracy (50 Hz to 20 kHz):	All ranges except 0.1 mA range (25±5°C); ±0.3% rdg. ±0.02% f.s. for 3 months. 0.1 mA range (25±1°C); ±0.5% rdg. ±0.2% f.s. for 3 months.
Full-Scale Step Response:	3 seconds to rated accuracy.
Maximum Input:	100% above range selected without damage. Input fused at 1.5 A.

RESISTANCE

RANGE	CURRENT THRU RX	RX	RESOLUTION
1.0000 kΩ	5 mA	1 kΩ	0.1 ohm
10.000 kΩ	500 µA	10 kΩ	1 ohm
100.00 kΩ	50 µA	100 kΩ	10 ohms
1000.0 kΩ	5 µA	1000 kΩ	100 ohms
10.000 MΩ	0.5 µA	10 MΩ	1000 ohms

Overrange:	30% on all ranges. Maximum readings are 1.3000 kΩ, 13.000 kΩ, 130.00 kΩ, 1300.0 kΩ, and 13.000 MΩ at full accuracy.
Configuration:	Two-wire measurement system.
Accuracy:	All ranges (25±5°C); ±0.1% rdg. ±0.01% f.s.
Full-Scale Step Response:	Typical 1 second on all kΩ ranges; 3 seconds on 10 MΩ range.
Voltage Protection:	130 V rms without damage on any range.

GENERAL

Input Configuration:	Fully floating and guarded in all functions.
Maximum Common Mode Voltage:	±500 V dc or peak V ac.
Range Selection:	Manual by front-panel control.
Sample Rate:	Continuously adjustable by front-panel control from 3 readings/second to 1 reading/10 seconds. HOLD position enables external measurement command.

GENERAL (Cont'd)

Display:	Full four-digits plus overrange digit (gas discharge tubes); automatic decimal point positioning for all functions and ranges; negative polarity indicator; display storage for non-blinking readout; offscale indication.
Operating Temperature:	0°C to +50°C.
Humidity Range:	0 to 80% Relative Humidity (0°C to +35°C). 0 to 70% Relative Humidity (+35°C to +50°C).
Dimensions:	3-1/2" H x 8-1/2" W x 13" D half-rack size portable package, including two side-carry handles.
Weight:	8 lb (3.6 kg) net; 13 lb (6 kg) shipping. Optional battery pack adds 4 pounds.
Power:	115/230 (±10%) V ac, or 100/200 (±10%) V ac, 48-440 Hz, 8 watts maximum.

1.3 OPTIONAL FEATURES

DIGITAL OUTPUTS (OPTION 05)	Nonisolated 8-4-2-1 BCD outputs and recorder control signals with DTL/TTL compatible logic levels. DATA RECORDER COMMON MUST BE ISOLATED FROM MEASUREMENT SOURCE COMMON. *Note: Output signals are not short-circuit-proof.*
Outputs:	4 digits of BCD, and "1" (true) bit for overrange, minus polarity, and print command. Binary "0" (false) = +2.4 to +5 V, 0.1 mA source. Binary "1" (true) = 0 to +0.5 V, 1.8 mA sink.
Inputs:	Single line contact closure to P.S. Common for external READ-ON-DEMAND (single measurement per command), and RECORDER BUSY (inhibit), and STOP (completes measurement in progress).

INTERNAL BATTERY PACK (OPTION 09)	Provides 6 hours of continuous operation between charges; 16-hour recharge cycle through built-in charger. Charges from external power line with instrument in operation. Internal batteries do not increase size of instrument. Three-way battery power switch on rear panel: 1) BATTERY OFF - Operates from power and recharges batteries. 2) BATTERY ON - Operates from internal batteries or external floating +12 V dc source which may be connected internally through rear-panel port. Instrument draws 0.7 A. 3) BATTERY TEST - Checks internal battery condition from front-panel display; also, verifies instrument performance.

CHAPTER 2
INSTALLATION

2.1 INTRODUCTION

The SD Model 7004A Digital Multimeter is shipped in an operational condition and is essentially ready for use as received. This chapter outlines the procedures for initial inspection and installation of the instrument. Instructions for reshipment are also included should the unit be returned to Systron-Donner Corporation for service or repair.

2.2 RECEIVING INSPECTION

Prior to accepting the meter from the shipper, inspect the condition of the shipping container for any indication of freight damage. Any sign of such damage must be noted by both the shipper and receiver and should be reported to the insurance investigator.

Immediately following removal of the instrument from the shipping carton, inspect for possible physical damage incurred during shipment. Check surfaces for scratches or dents and note condition of knobs and connectors. Should any damage be noted, notify your nearest Systron-Donner representative---DO NOT USE THE METER UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2.3 RESHIPMENT

When the instrument is to be repackaged for shipment use the original packing materials. Your Systron-Donner field office can provide materials similar to those used for the original factory packaging, or repackage the instrument following these general instructions:

GENERAL PACKING INSTRUCTIONS

1) Attach a tag to the unit indicating the model number, serial number, name and address of the instrument owner, and a summary of the service or repairs required.

2) Wrap the instrument in heavy paper or plastic prior to placing it into the shipping container.

3) Select a strong carton or wooden box to house the instrument.

4) Use an adequate layer of shock-absorbing material on all sides of the instrument and protect the front panel with additional layers of cardboard. Be certain that there is no movement of the unit within the container.

5) Seal the package with strong tape or metal bands.

6) Mark the shipping container "FRAGILE-DELICATE INSTRUMENT" to ensure careful handling.

7) Be certain that all correspondence refers to full instrument nomenclature (model and serial number).

2.4 POWER REQUIREMENTS

Model 7004A Digital Multimeter is equipped with a standard three-conductor power cord which,when plugged into an appropriate power receptacle, grounds the chassis to protect operating personnel from certain electrical hazards. Whenever the power cord is mated to a two-conductor outlet,a cord adapter-plug (properly installed) will provide the same protection.

The instrument operates from either 115 or 230 V at 48 to 440 Hz and consumes approximately 8 watts of power. A LINE switch on the rear panel adapts the unit for the local power line voltage. A 100/200 V tap on the primary of the power transformer is also provided to accommodate certain other power line requirements.

NOTE

The Model 7004A is shipped with a .3 ampere Slo-Blo (115 V operation). If 230 V operation is required, the .3 ampere fuse should be replaced with a .15 ampere Slo-Blo fuse to adequately protect the meter.

2.5 ACCEPTANCE TEST PROCEDURE

The following procedure is performed to verify that no damage has occurred during transit and that the instrument is operative.

NOTE

Prior to performing the Acceptance Test Procedure it is recommended that the user become familiar with the instrument controls described in Section 3, OPERATION.

1) Check position of the LINE (115/230 V or 100/200 V) switch and connect ac power cord to an appropriate power source. If Internal Battery Pack (Option 09) is provided, turn BATTERY switch to the OFF position.

2) Turn POWER switch to the ON position; the display will illuminate.

3) Select controls indicated in Table 2.1 and observe the display readings.

TABLE 2.1 ACCEPTANCE TEST PROCEDURE

FUNCTION	RANGE	INPUT	DISPLAY
V	1000	HI/LO/GUARD SHORTED	0000.0±3 DIGITS
V & AC	1000	" " "	" "
mA	1000	" " "	" "
mA & AC	1000	" " "	" "
KΩ	1000	" " "	" "
KΩ	1000	HI/LO OPEN	OFFSCALE READING WITH OFFSCALE INDICATOR ENERGIZED.

4) After completion of the Acceptance Test Procedure, refer to Section 3, OPERATION for additional operating information.

CHAPTER 3
OPERATION

3.1 INTRODUCTION

This chapter describes general operation of the Model 7004A Digital Multimeter. Front panel and rear panel functions are described in Tables 3.1 and 3.2. Operating procedures are given in Table 3.3. Also included is information concerning factors which affect measurement accuracy.

3.2 CONTROLS, CONNECTORS AND INDICATORS

3.2.1 Front Panel

Front Panel control functions for Model 7004A are described in this section (see Figure 3.1 and Table 3.1).

TABLE 3.1 FRONT PANEL FUNCTIONS

INDEX	NAME	FUNCTION
1	POWER-OFF (switch)	Applies power to the instrument when turned in the clockwise direction.
2	SAMPLE RATE and HOLD (Potentiometer and Switch)	Controls measurement sample-rate of 3 readings/second to 1 reading/ 10 seconds as knob is turned in clockwise direction. When in HOLD position, measurement cycle is interrupted until externally commanded by remote programmer ($\overline{\text{Read}}$).
3	HI/LO (Post Connectors)	Input terminals for all measurement functions.
4	GUARD (Post Connector)	Internal guard circuit may be left open (unconnected), or can be bussed to the LO terminal. It may also be connected to an external guard potential. The guard circuit, when utilized, provides increased ac/dc common mode rejection of spurious or undesired signal currents.

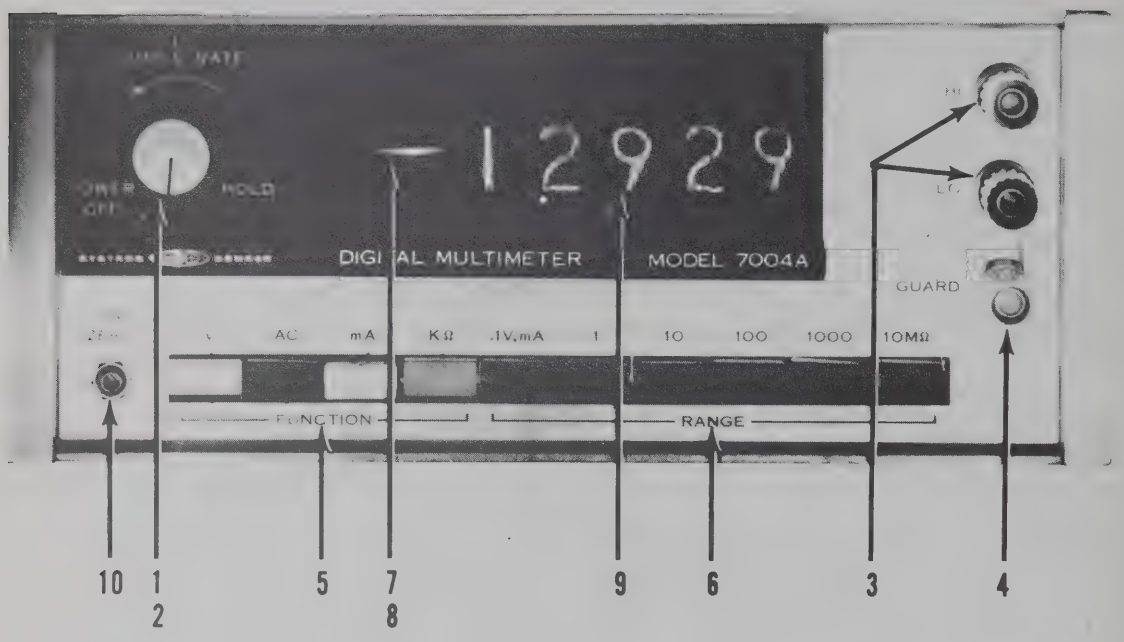


FIGURE 3.1 FRONT PANEL, MODEL 7004A

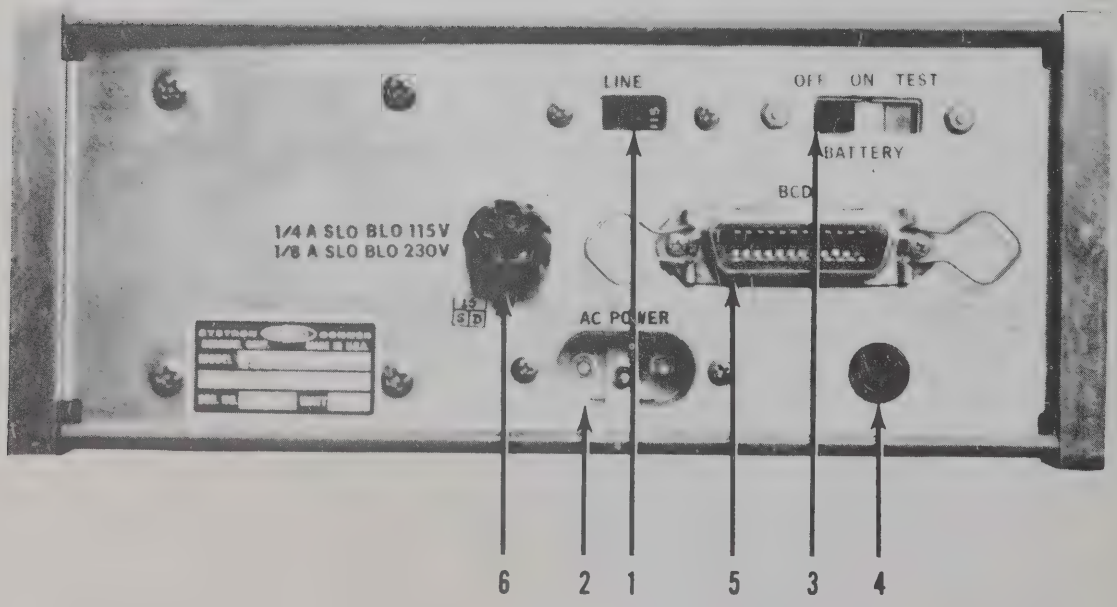


FIGURE 3.2 REAR PANEL, MODEL 7004A

TABLE 3.1 FRONT PANEL FUNCTIONS (Cont'd)

<table>
<tr><td>5</td><td>FUNCTION (Pushbutton Switches)

V (white)
AC (red)
mA (white)
KΩ (grey)</td><td>Pushbutton switches initiate the following measurements:

FUNCTION — PUSHBUTTON

dc voltage — depress V
dc current — depress mA
ac voltage — depress V & AC
ac current — depress mA & AC
resistance — depress KΩ</td></tr>
<tr><td>6</td><td>RANGE</td><td>Pushbutton switches select the following ranges:

RANGE — AC/DC VOLTS — AC/DC CURRENT — KΩ RESISTANCE

.1V,mA — X — X — No
1 — X — X — X
10 — X — X — X
100 — X — X — X
1000 — X — X — X
10 MΩ — No — No — X</td></tr>
<tr><td>7</td><td>Off-Scale Indicator</td><td>LED display, when lighted, indicates an off-scale condition.</td></tr>
<tr><td>8</td><td>Polarity Indicator</td><td>Negative polarity dc measurements are indicated with a (-) sign. Positive polarity levels have no sign indication.</td></tr>
<tr><td>9</td><td>Readout Tubes</td><td>Full four-digit display, with over-range (1), provides full scale readout and 30% overrange capability. Decimal point indication is determined by the range selected.</td></tr>
<tr><td>10</td><td>mV ZERO (Screwdriver Adjustment)</td><td>Fine (screwdriver) adjustment for zeroing low-range mV readings when high-resolution accuracy is desired.</td></tr>
</table>

3.2.2 Rear Panel

Rear Panel control functions for Model 7004A are described in this section (see Figure 3.2):

TABLE 3.2 REAR PANEL FUNCTIONS

INDEX	NAME	FUNCTION
1	LINE (Switch)	Slide switch selects 115/230 (±10%) V ac, 48 to 440 Hz operation. Power transformer tap (modification) converts unit to 100/200 (±10%) V ac operation.
2	AC POWER (Three-conductor power receptacle	Power receptacle mates with standard three-conductor power cord (supplied).
3	BATTERY (Switch)	Option 09, Internal Battery Pack-permits field operation of Model 7004A. *OFF Position:* Instrument operates from ac power line while batteries are charging continuously. *ON Position:* Disconnects ac power line; instrument operates from internal battery pack. *TEST Position:* Internal battery voltage is indicated on front-panel readout. Instrument accuracy will be impaired if internal battery pack voltage drops below 11 V dc.
4	EXTERNAL BATTERY (Cable Port)	Provision included for connecting external 12 V dc (nominal) power supply into the instrument. *Do not exceed 13.5 V dc or damage may result.)*
5	BCD Output (Connector)	Option 05, Digital Outputs - provides non-isolated 8-4-2-1 BCD levels and DTL/TTL compatible recorder control logic levels. Mating connector is Amphenol #57-30240 (24 pins).

TABLE 3.2 REAR PANEL FUNCTIONS (Cont'd)

5	BCD Output (Cont'd)	BCD Connector Pin Assignments (J201) READOUT / BCD / PIN 10^3: $\overline{1}$ 7; $\overline{2}$ 8; $\overline{4}$ 19; $\overline{8}$ 20 10^2: $\overline{1}$ 5; $\overline{2}$ 6; $\overline{4}$ 17; $\overline{8}$ 18 10^1: $\overline{1}$ 3; $\overline{2}$ 4; $\overline{4}$ 15; $\overline{8}$ 16 10^0: $\overline{1}$ 1; $\overline{2}$ 2; $\overline{4}$ 13; $\overline{8}$ 14 Recorder Control Pin Assignments (J201) FUNCTION / PIN P.S. Common (Gnd) 24 $\overline{\text{Minus Polarity}}$ 21 $\overline{\text{Overrange}}$ 9 $\overline{\text{Print Command}}$ 23 $\overline{\text{Read}}$ 11 $\overline{\text{Stop}}$ 22 $\overline{\text{Inhibit}}$ 10
6	FUSE (Holder)	Contains .3 A 3AG Slo-Blo fuse for 115 V operation or .15 A Slo-Blo fuse for 230 V operation.

3.3 OPERATING PROCEDURES

The general method for operating Model 7004A is indicated in Table 3.3. All inputs are applied between HI/LO terminals; with the GUARD circuit connected to the LO terminal whenever possible.

TABLE 3.3 OPERATING PROCEDURES

FUNCTION	OPERATION	DISPLAY
DC VOLTS	Select V and desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in dc volts.
DC CURRENT	Select mA and desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in dc milliamperes.
AC VOLTS	Select V and AC with desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in ac volts.
AC CURRENT	Select mA and AC with desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in ac milliamperes.
RESISTANCE	Select KΩ and desired RANGE 1, 10, 100, 1000, or 10 MΩ	Read display directly in kilohms on the 1, 10, 100, 1000 ranges, and in megohms on the 10 MΩ range.

3.3.1 Sample Rate and Hold Control

This control varies the measurement sample rate over the range of 3 readings/second to 1 reading/10 seconds. When set to the HOLD position, the last reading is displayed until the control is returned to the SAMPLE RATE position; or, a remote command is received on $\overline{\text{READ}}$ line (Pin 11) of connector J202.

3.3.2 Guard Terminal

The instrument contains two isolated inner chassis (top and bottom guard covers) connected to the GUARD terminal on the front panel. With the GUARD/LO terminals bused together, measurement errors due to ac or dc normal mode currents are reduced significantly. Although the GUARD terminal is usually bussed to the LO terminal, in certain applications it may be advantageous to connect it to a separate Guard Voltage.

3.3.3 Overload Protection

Overload protection is provided on all ranges to the extent indicated below:

1) DC VOLTS - ±1000 V (maximum allowable input) on all ranges.

3.3.3 Overload Protection (Cont'd)

2) AC VOLTS - 500 V rms on 10 V, 100 V, 1000 V ranges.
150 V rms on 0.1 V, 1 V ranges.

3) DC CURRENT - 100% above selected range, on all ranges.

4) AC CURRENT - 100% above selected range, on all ranges.

5) RESISTANCE - 130 V rms on all ranges.

3.3.4 mV Zero Adjustment

Located on the Model 7004A front panel is the mV ZERO adjustment. This control permits the user to accurately zero the instrument when low-level, high-resolution measurements are to be made on the 0.1 V range.

Before adjusting this control, allow the instrument to stabilize for at least 1/2 hour after turn-on. Connect a zero-ohm shorting bus across the HI/LO terminals and adjust the mV ZERO control until a reading of .00000 V ±2 counts is obtained.

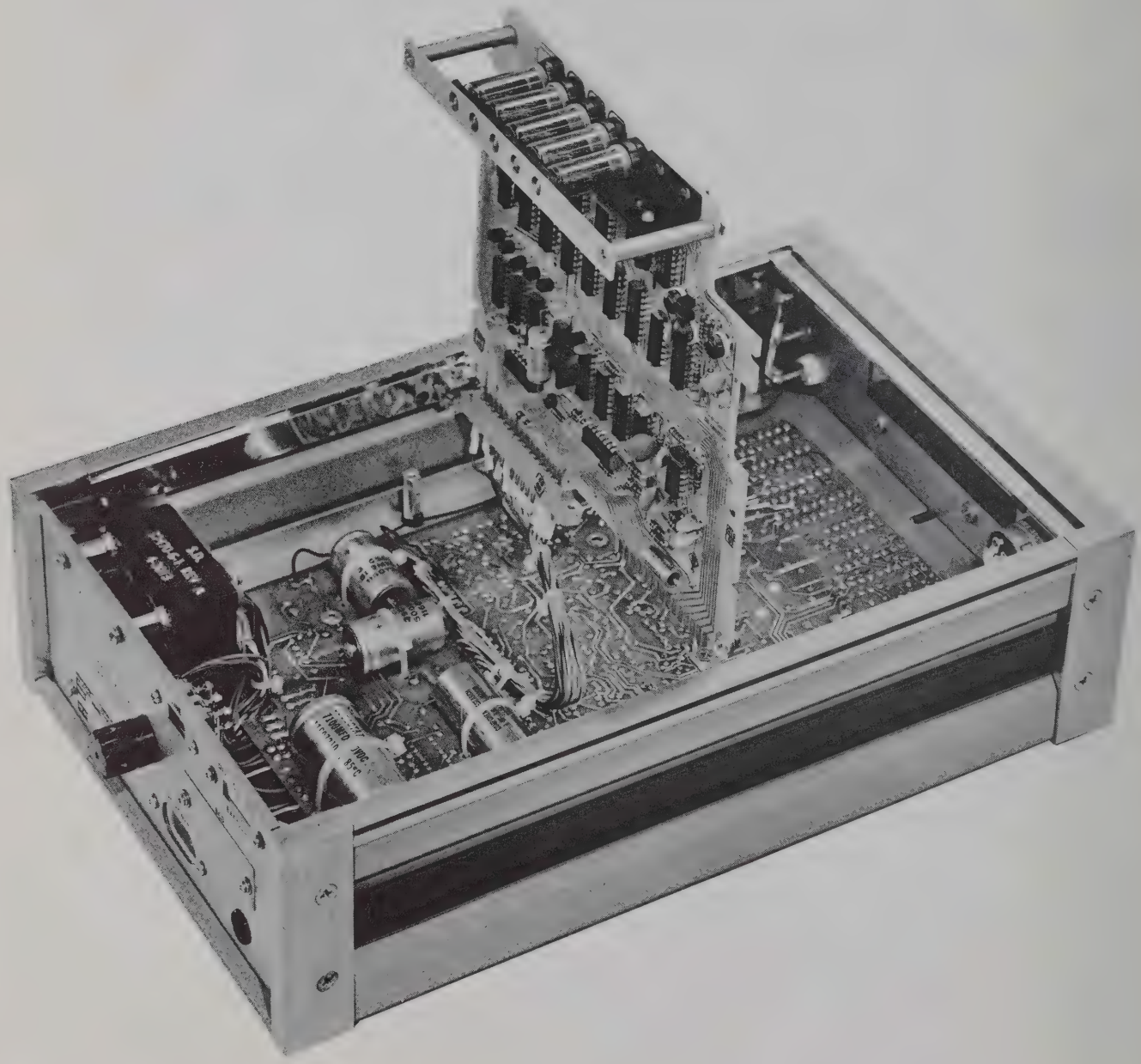


FIGURE 3.3 MOUNTING THE A1 READOUT BOARD FOR ACCESS TO A1 READOUT BOARD AND BOTTOM OF A2 SWITCH BOARD

CHAPTER 4
MAINTENANCE

4.1 INTRODUCTION

This section contains basic maintenance and calibration procedures for maintaining Model 7004A performance parameters. Information in this section includes: Factory Service, Routine Maintenance, Printed-Circuit Board Repair, Test Equipment, and Calibration Procedures.

4.2 FACTORY SERVICE

Whenever a Systron-Donner instrument requires service, the nearest S-D representative should be contacted. He can provide field service,or arrange factory service when necessary. Address all inquiries concerning service, operation, or application to your nearest sales representative; or, to Sales Manager:

SYSTRON-DONNER CORPORATION
CONCORD INSTRUMENT DIVISION
10 Systron Drive
Concord, California 94518
Phone: (415) 682-6161
TWX: 910-481-9479
Cable: SYSTRONDONNER

4.3 ROUTINE MAINTENANCE

A regular program for maintenance and inspection every four to six months is recommended for this unit. As part of these regular procedures, the instrument should be checked in the following manner:

1) Disconnect ac power and remove the top and bottom covers.

2) Make a thorough visual inspection of all wiring and cables. Check for frayed, loose, or burned wires.

3) Check the physical integrity of all components. Look for burned or cracked components, loose solder connections, leakage of insulation compounds, and general physical damage. When a printed-circuit board contains integrated-circuit packages, ensure that all packages are firmly mounted. Never unnecessarily remove and replace a package.

4) Check front panel switches and controls for loose or broken terminals, sticking shafts, etc.

5) If the internal panel surfaces and components have accumulated an excessive amount of dust, use a soft brush and low-pressure stream of air to remove the foreign material.

CAUTION

Do not clean P.C. boards or small internal components with a stiff brush or solvents since damage to the circuits may result. A high-powered vacuum cleaner device should never be used on small internal components.

6) Wipe the external surfaces of the instrument with a soft, damp cloth to remove dirt, fingerprints, and other foreign materials.

7) Replace the top and bottom covers and reconnect ac power. Perform the operational test procedures given in Section 4.6. If performance does not match or exceed the specifications listed in Chapter 1 of this manual, corrective maintenance is in order.

4.4 PRINTED-CIRCUIT BOARD REPAIR

When replacing integrated circuits or other electronic components soldered to printed-circuit boards, the procedures indicated below must be followed or damage to the board may result:

1) Determine by troubleshooting techniques, which integrated circuit or discrete component(s) has failed.

2) Remove the defective component(s) from the board by cutting the pins or leads with a small diagonal clipping tool. (Always remove and replace the entire component.)

3) Apply heat (40-50 W soldering iron) sparingly to each of the cut pins or leads and remove from the board; clean the hole(s) with a toothpick or solder suction tool.

4) Form the tinned leads of the replacement part and insert in the printed circuit holes; solder, then trim leads to extend 1/16-inch beyond the back surface of the board. (Use only 63-37 solder with maximum 1/16-inch diameter.)

CAUTION

Always trim semiconductor leads only after soldered installation is complete. This procedure greatly lessens the possibility of component failure due to shock-wave damage caused by the trimming tool.

4.4 PRINTED CIRCUIT BOARD REPAIR (Cont'd)

5) When soldering semiconductor devices and all small components, be sure to use a heat sink tool or long-nosed plier connected to the component lead(s) while each is being soldered. Allow the soldered connection to cool before removing the heat sink.

6) Clean all dirt and solder-flux from the printed-circuit traces by liberal application of a freon-type solvent.

4.5 TEST EQUIPMENT

Listed in Table 4.1 is the inventory of test equipment required for maintenance and calibration of the Model 7004A Digital Multimeter. In the event these specific items are not available, units of equal, or greater accuracy and capability may be used.

TABLE 4.1 TEST EQUIPMENT FOR MODEL 7004A

NOMENCLATURE	TYPE	USAGE
DC Voltage/Current Calibrator	Fluke Model 382A & 332B	dc voltage & current calibration
AC Voltage Calibrator	HP Model 745A (Use 0.1% resistors for ac current calibration)	ac voltage & current calibration
Resistance Standard	ESI Model RS925C	resistance calibration
Digital Voltmeter	Systron-Donner Model 7205	calibration & troubleshooting
Oscilloscope	Tektronix Model 535 with Type D Plug-in	calibration & troubleshooting

4.6 CALIBRATION PROCEDURES

This section contains step-by-step calibration procedures for the Model 7004A. Perform these procedures in listed order since earlier steps may affect later ones.

Test and calibration tolerances listed in these procedures do not include specification variances of the test/calibration equipments listed in Table 4.1.

Unless otherwise indicated, all calibration procedures may be conducted while at room ambient temperature and at nominal power-line voltage and frequency.

For best results use high-quality test leads of 36-inch maximum length. Undesirable noise may be eliminated during the calibration procedures by grounding the LO/GUARD terminals to the test/calibration equipment.

4.6.1 Power Supply Voltages

1) Remove bottom instrument cover (rear end-trim; slide cover off), apply power, and check power supply voltages (bottom side, P.C. board) as follows:

TABLE 4.2 POWER SUPPLY VOLTAGES

VOLTAGE	TEST POINT	ADJUSTMENT	TOLERANCE
+17 V dc	Green	Fixed	Nominal
-18 V dc	Yellow	Fixed	Nominal
Ground	Red/Black	-	-

2) Turn OFF power; replace instrument cover.

4.6.2 Calibration

1) Apply power to instrument and allow at least 1/2-hour warm-up.

2) Remove bottom instrument cover

3) TRANSFORMER UNBALANCE COMPENSATION: Compensation for transformer unbalance has been made at the factory to eliminate display "noise" or uncertainty. This compensation is adequate for most ac power sources at the point of manufacture. When this unit is used with differing or special power sources, it may be desirable to rebalance the power transformer. This may be done using the following procedure:

   Short across the HI, LO, and GUARD inputs. Remove side panel cover and set FUNCTION switch to V and RANGE switch to .1 V, mA. Monitor ripple voltage across Main Amplifier output TP-6, with respect to LO terminal. Connect a capacitor across guard post 22 and Main Amplifier supply post 23 or 24 for a minimum output. The value of the capacitor may vary between 10 pF to 400 pF (typical value is 56 pF). The output

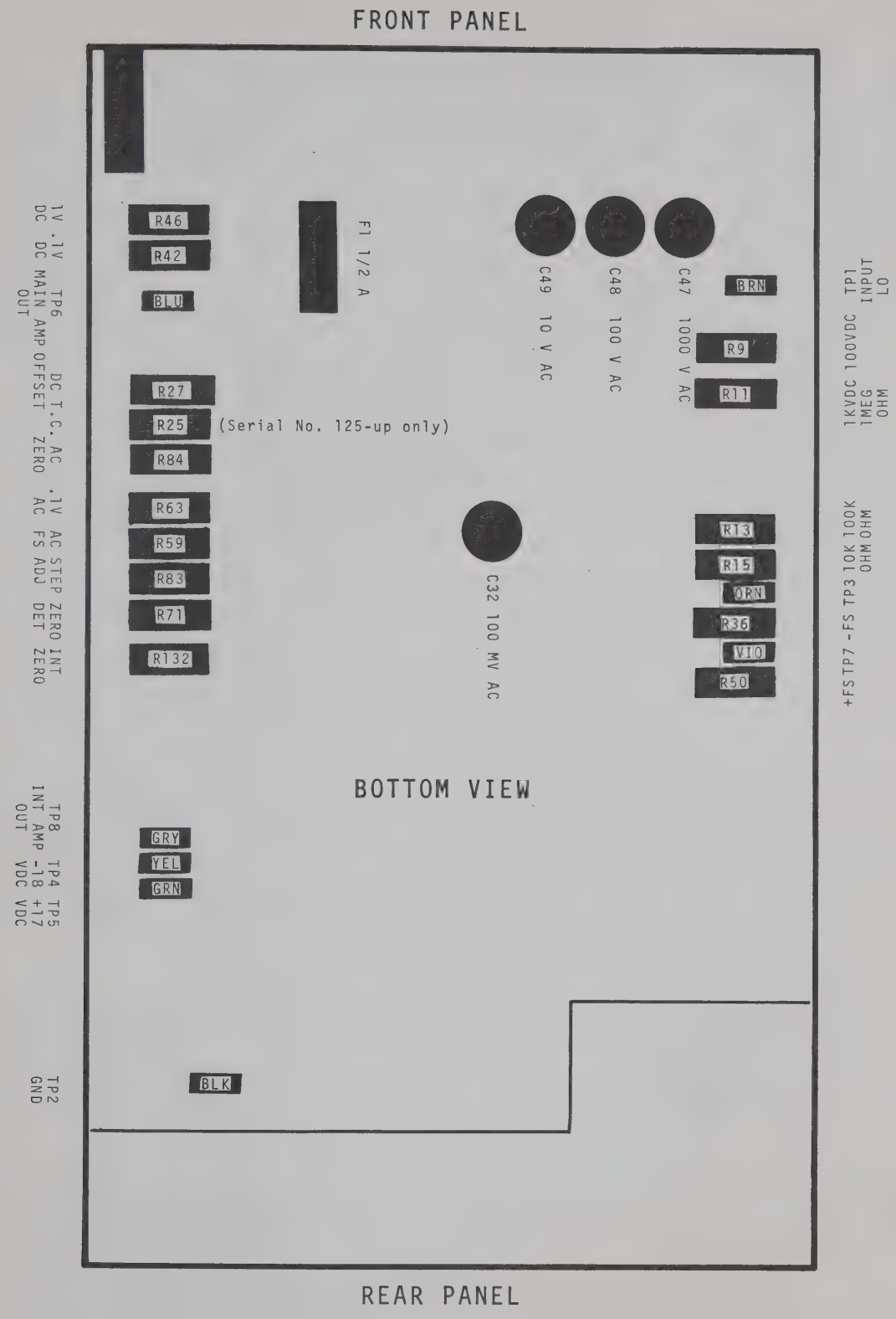


FIGURE 4.1 LOCATION, CALIBRATION CONTROLS

should be minimum but no more than 50 mV p-p. Occasionally the transformers are well balanced and may not require any capacitance.

With the instrument still on the .1 V DC RANGE, adjust the DC OFFSET potentiometer A2R27 to adjust the main amplifier output to 0.0 V ±5 mV dc. Measure the voltage with a DVM between the INPUT LOW terminal, and the MAIN AMP OUT test point A2TP6. If the DC OFFSET potentiometer does not have sufficient range, adjust the T.C. potentiometer A2R25 toward the center of its range or until a zero can be obtained.

4) INTEGRATOR ZERO: Place the FUNCTION and RANGE switches to the 10 V DC position. Monitor the integrator output, INT AMP OUT, at A2TP8 with respect to INPUT LOW with an oscilloscope. Adjust the INT ZERO potentiometer A2R132 until a minimum amplitude ramp is observed.

   The ramp slope should increase in either a + or - direction depending on potentiometer rotation from the proper zero setting.

5) DETECTOR ZERO: Adjust ZERO DET potentiometer A2R71 until the polarity sign flashes on and off intermittently.

6) STEP ADJUST: Remove short across the input and apply +10 mV dc (10 counts). Adjust STEP ADJ potentiometer A2R83 to read +10 counts. Next, apply -10 mV dc (10 counts). The readout should display -10 counts. If not, adjust ZERO DET potentiometer A2R71 until the + and - readings are equal, then readjust STEP ADJ potentiometer A2R83 until ±10 counts are obtained with a ±10 mV dc input.

7) INPUT MAIN AMPLIFIER ZERO: This adjustment is done in two parts. First DC OFFSET is adjusted for minimum output at room temperature and then the T.C. pot[1] (Temperature Compensation) is calibrated at 75°C. In order to obtain the proper setting, the procedure described below should be followed:

   a) Place the FUNCTION and RANGE switches in V and .1V,mA position, and SAMPLE RATE at maximum. Short the HI and LO input terminals and GUARD together.

   b) Set the mV ZERO pot (front panel control) to the electrical center of its range. Procedure: Adjust to both mechanical extremes observing the maximum zero offset in each direction. Readjust to the number midway between the extremes.

1 This is factory adjusted and need not be performed unless parts have been replaced in the Input Main Amplifier.

c) Set the T.C. pot A2R25 to the electrical center of its range. Procedure: Adjust to both mechanical extremes observing the maximum zero offset in each direction. Readjust to the number midway between the extremes.

d) Readjust DC OFFSET potentiometer A2R27 to zero the instrument.

e) Adjust the T.C. pot A2R25 to produce a reading of +.00200 ±1 count.

f) Place a thermal probe, stabilized at 75°C, on dual FET A2Q1 for a period of approximately one minute.

g) Remove the thermal probe and record the first reading (r_1) after the probe is removed. (Typically more positive than +.00200)

h) Adjust the T.C. pot A2R25 to produce a reading of -.00200 ±1 count. Observe that the FET has cooled to approximately room temperature and that the reading remains stable.

i) Place the 75°C thermal probe on Dual FET A2Q1 again for approximately one minute.

j) Remove the thermal probe and record the first reading (r_2) after removal (typically more negative than -.00200).

k) Determine the CHANGE of each reading (y_1,y_2) and plot the points on linear graph paper with XY scales. Two typical curves are plotted in the example to demonstrate positive and negative compensation settings.

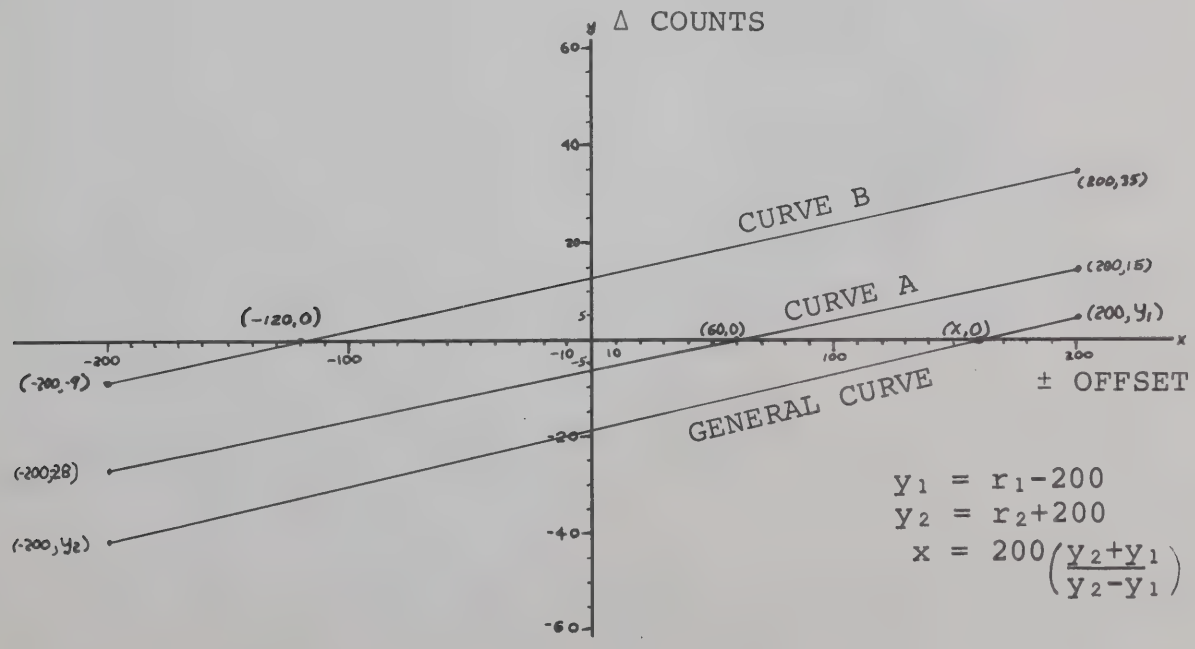


FIGURE 4.2 TYPICAL TEMP. COMP. GRAPH

l) Draw a straight line curve through the two points, and note the point of intersection with the ±OFFSET scale, x-axis.

m) Adjust T.C. pot A2R25 to produce a reading equal to the number of counts shown by the intersection on the graph. In the above example the reading should be +.00060 for Curve A and -.00120 for Curve B.

n) Readjust DC OFFSET pot A2R27 to zero the instrument.

o) Verification of proper temperature compensation may now be performed. Observe the reading at .00000 ±1 count, if not, adjust the front panel mV ZERO adjustment to produce this reading. Place the 75°C thermal probe on Dual FET Q1 for approximately one minute. Remove the probe and observe the reading is still .00000 ±20 counts. This procedure will typically compensate the FET to ±5 counts (±50 μV) for a 50°C change in temperature. If the 25°C to 75°C zero stability of the FET is not less than ±20 counts after compensation, it may be due to improper performance of the compensation procedure, or a defective device with excessive gate leakage current.

8) +FS (TP7-violet): Apply +10 V dc across the inputs and adjust +FULL SCALE potentiometer A2R50 to read 10.000 ±1 count.

9) -FS (TP3-orange): Apply -10 V dc across the inputs and adjust -FULL SCALE potentiometer A2R36 to read -10.000 ±1 count.

10) OHMS CALIBRATION: Set FUNCTION switch to KΩ and select RANGE as indicated in Table 4.3:

TABLE 4.3 RESISTANCE CALIBRATION

RANGE	CALIBRATOR INPUT	ADJUST	DISPLAY	(INITIAL) (ADJUSTMENT)	(FINAL) (CALIB)
1	1 kΩ	No adjustment	1.0000	±11 counts	±11 counts
10	10 kΩ	A2R15	10.000	±1 count	±11 counts
100	100 kΩ	A2R13	100.00	±1 count	±11 counts
1000	1000 kΩ	A2R11	1000.0	±1 count	±11 counts
10 MΩ	10 MΩ	No adjustment	10.000	±11 counts	±11 counts

11) DC VOLTAGE CALIBRATION: Set FUNCTION switch to V and select RANGE as indicated in Table 4.4:

TABLE 4.4 DC VOLTAGE CALIBRATION

RANGE	CALIBRATOR INPUT	ADJUST	DISPLAY
.1	±100 mV	A2R42	.10000 ±2 counts
1	±1 V	A2R46	1.0000 ±1 count
10	±10 V	Same as 6) & 7)	10.000 ±1 count
100	±100 V	A2R9	100.00 ±1 count
1000	±1000 V	A2R13	1000.0 ±2 counts

NOTE

If adjustment of A2R13 is necessary, the Resistance ranges may be slightly affected, but these will continue to be within specified tolerances. Also, do not attempt at this point, to readjust the Resistance ranges back to ±1 count since the DC Voltage calibration will then be affected.

12) AC VOLTAGE CALIBRATION: *(Perform DC VOLTAGE CALIBRATION first).*

a) AC ZERO: Set FUNCTION switches to V and AC. Set RANGE switch to 0.1 V mA. Short the HI/LO input terminals with a bus jumper. (Do not use long test leads which will pick up noise.) Adjust AC ZERO A2R84 so that display reads a minimum, but no higher than 15 counts.

b) Apply a 0.1 V rms, 200 Hz input signal from the AC Voltage Calibrator across the HI/LO input terminals. Adjust A2R63 until the readout is .10000 ±1 count.

c) Apply a 0.1 V rms, 20 kHz input signal across the HI/LO input terminals. Adjust frequency compensation capacitor A2C32 until the readout is .10000 ±1 count.

d) Set the RANGE switch to the 1 V range. Apply a 1.0 V rms, 200 Hz input signal across the HI/LO input terminals. Adjust A2R59 until the readout is 0.9995 ±2 counts.

e) Set the RANGE switch to the 10 V range. Apply a 10 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 10.000 ±22 counts.

f) Apply a 10 V rms, 20 kHz input signal across the HI/LO input terminals. Adjust attenuator frequency compensation capacitor A2C49 for a reading of 09.990 ±2 counts.

g) Set the RANGE switch to the 100 V range. Apply a 100 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 100.00 ±22 counts.

h) Apply a 100 V rms, 20 kHz input signal across the HI/LO input terminals. Adjust attenuator frequency compensation capacitor A2C48 for a reading of 099.90 ±2 counts.

i) Set the RANGE switch to the 1000 V range. Apply a 500 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 500.0 ±12 counts.

j) Apply a 500 V rms, 10 kHz input signal across the HI/LO input terminals. Adjust attenuator frequency compensation capacitor A2C47 for a reading of 0499.5 ±1 count.

k) In the event that an AC Voltage Calibrator with an output capability of 500 V rms is not available, the following procedure will provide adequate frequency compensation. Apply a 100 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 100.0 ±4 counts.

l) Apply a 100 V rms, 10 kHz input signal across the HI/LO input terminals. Adjust attenuator frequency compensation capacitor A2C47 to observe a reading of 99.8 ±1 count.

13) DC/AC CURRENT CALIBRATION

a) DC CURRENT: Set FUNCTION switch to mA and RANGE switch as indicated below. Connect DC Current Calibrator output across the HI/LO input terminals. Observe display, no adjustment is required.

TABLE 4.5 DC CURRENT CALIBRATION

RANGE	CALIBRATOR INPUT	DISPLAY	
.1	±100 µA	.10000	±14 counts
1	±1 mA	1.0000	±11 counts
10	±10 mA	10.000	±11 counts
100	±100 mA	100.00	±11 counts
1000	±1000 mA	1000.0	±11 counts

b) AC CURRENT: Set FUNCTION switch to AC and mA; then, repeat Step 11a. Use AC Current Calibrator. If not available, apply ac voltage across precision resistors to obtain proper currents.

TABLE 4.6 AC CURRENT CALIBRATION

RANGE	CALIBRATOR INPUT	DISPLAY	
.1	100 µA	.10000	±52 counts
1	1 mA	1.0000	±32 counts
10	10 mA	10.000	±32 counts
100	100 mA	100.00	±32 counts
1000	1000 mA	1000.0	±32 counts

CHAPTER 5
THEORY OF OPERATION

5.1 INTRODUCTION

This chapter presents the theory of operation for the Model 7004A Digital Multimeter. Included in this description is a general presentation of dual-slope integration, followed by a detailed discussion of the A1, Count Chain & Readout Board, and the A2, Switch Board.

5.2 DUAL-SLOPE INTEGRATION

The method of dual-slope integration, as used in the Model 7004, is a two-step analog to digital measurement technique. The first step is characterized by an ultra-high impedance input operational amplifier which provides extremely high input impedance plus gain on the lowest ranges. At the start of the measurement period, control circuits connect the amplifier output to the integrator, remove the short from the integrating capacitor, and open the gate so that pulses will pass from the oscillator to the counter. Since the integrating capacitor was just shorted, the integrator output starts from zero. This output is a ramp with slope and direction proportional to the instantaneous amplitude and polarity of the input voltage. The integration continues until 10,000 counts from the oscillator have been accumulated. With an oscillator frequency of 100 kHz this occurs in 1/10th of a second.

At this time the second step of the measurement cycle begins. The integrator input switches to the reference supply, the polarity of which is chosen to be opposite that of the input voltage. The counter continues to count while the reference voltage now drives the integrator back to zero. The slope of the decreasing voltage from the integrator is proportional to the reference voltage and the time required to drive the integrator back to zero is direct proportional to the unknown input. When the integrator reaches zero the gate is closed and the counter is stopped. This count is now numerically equal to the unknown input voltage and is transferred into memory and displayed as the final answer.

Several features of Dual-Slope Integration should be noted:

1) The same integrator is used during both halves of the measurement cycle which essentially eliminates the problems usually inherent in integrator circuits such as component aging and temperature drift. It is only necessary for the integrator to maintain the same characteristics from the first to the second half of the measurement cycle.

5.2 DUAL-SLOPE INTEGRATION (Cont'd)

2) The same clock oscillator is used during both halves of the measurement cycle; its frequency need only remain constant for a very short period.

3) The input is always compared to an internal reference for each measurement.

5.3 A1, COUNT CHAIN & READOUT (Schematic 37215-7-1)

This assembly contains the timing and control logic, the polarity and off-scale indicators, and the digital count chain and readout. Generally, the operations on this board will be described in sequence unless otherwise noted.

At the beginning of a new integrating cycle, $\int ex$, the unknown voltage, ex, from the main amplifier, A2U1, is coupled through FET switch, A2Q15, which is held on by a low level on the $\overline{\int ex}$ line. At the same time a high on the $\int ec$ line turns off the FET switch A2Q12 and removes the short across the integrating capacitor A2C41.

The clock, A1U16, operating at 100 kHz, produces a chain of pulses from pin 8 which is counted by decades, A1U10-U13 on pin 14. The clock output is gated through NAND gates A1U20, pins 3 & 6. After 10,000 pulses have been counted during $\int ex$, dual J-K, A1U5, produces two outputs. Pins 7 & 12 go high and 10 & 13 go low. Three functions occur: the clock is inhibited for 16 counts, integration of the unknown voltage, $\int ex$, is stopped, and integration of the proper reference $+\int er$ or $-\int er$ is started.

To stop the clock for 16 counts, the A1U5 J-K output from pins 7 & 12 turns on Q6. This presents a high on the NAND gate, A1U21 pin 2 where pin 3 is already high. This turns on the four-bit binary counter A1U21 which is wired for ÷16 counting. Decoder A1U22 keeps the output of A1U20 pin 8 low for 16 counts which stops the clock through the gate A1U2 pin 6.

Integration of the unknown voltage is stopped by the output of A1U5 pins 10 & 13 which toggles flip-flop A1U19 with a low on pin 5. The $\int ex$ line flips high and opens the FET switch A2Q15 shutting off the integration of the unknown voltage, ex.

Integration of the proper reference is started by the high output of flip-flop A1U19 pin 6 setting all the following NAND gate lines high: A1U16 pins 4 & 2 and A1U18 pins 9 & 12. During $\int ex$ the output of the zero detector A2U7 has either been high (negative ex) or low (positive ex). The output, X_0, from A2U7 (terminal 13) is fed to the A1U24 inverter. This high or low level is fed to A1U16 via inverter A1U15, pin 11, so that opposite levels appear at pins 1 & 5 of A1U16. For a negative

ex, pin 5 of A1U16 is high, w/pin 1 low, and pin 5 of flip-flop A1U16 is low; thus making pin 13 high and pin 11 low. With the $+\overline{\int er}$ line low, the +REF is coupled through FET switch A2Q13 to the integrator and positive integration $+\int er$, of the + reference begins. This integration is in the opposite direction to the unknown integration. Thus for a positive ex, the $-\int er$ line is low and the -REF is coupled through FET switch A2Q14 for negative integration, $-\int er$, of the - reference. The minus indicator is turned on for a low on pin 3 of A1U18 with positive polarity not shown.

The output of A1U17, at this time, presents the polarity on pin 5 of the BCD connector J101 and presents a low on the input pin 9 of NAND gate A1U15. Since pin 10 of NAND gate A1U15 is high, nothing happens. However, when the zero detector detects that the $\int er$ has integrated back to zero, the X_0 line changes polarity, switching the state of A1U24. This change of state, via A1U15 and A1U16, flips A1U18 which drives the output of A1U17 pin 6 and input of A1U15 pin 9 high. This high on pin 9 and the high already on pin 10 of A1U15 produces a low output, triggering the delay one-shot pins 6 & 3 of A1U15. This one-shot pulse does two things: the one-shot turns on the 5 ms clamp pins 8 & 11 of A1U19 which shuts the clock off, and this low on the $\overline{\int ec}$ line turns on FET switch A2Q12 and shorts the integrating capacitor A2C41.

Also, the delay one-shot A1U15 places a low on pin 1 of A1U14 which produces a high on the TRANSFER line and transfers the count from decades A1U10-U13 to buffer storages A1U5-U9. The OFF SCALE indicator lights when A1U25 decodes a count of 13000. The cycle is ready to begin again.

5.4 A2, SWITCH BOARD (Schematic 37217-7-1)

This assembly contains all of the analog electronics including the following circuits: DC Amplifier/DC current, AC-DC Converter/ AC Current, Ohms Circuit, A to D Converter, and Power Supply. Note: All switches are initially in the off position.

5.4.1 DC AMPLIFIER/DC CURRENT (Schematic 37217-7-1) Sheet 1 of 2)

The main dc amplifier consists of a switch-selected input attenuator, A2S9-C, A2S8-A-B-C, A2S7-B, A2S6-B, A2S9-A-B, and A2R8 through A2R16, followed by a passive filter, A2R17, A2R18, A2C5, A2C6, and a FET input, A2Q1, operational amplifier, A2U1. This amplifier has unity gain in the 10, 100, and 1000 ranges, a gain of 10 in the 1 range, and a gain of 100 in the .1 range. The input is developed across A2R35, A 10 kΩ resistor, with 10 volts full scale capability. To increase the good common mode characteristics of A2Q1, a transistorized current source, A2Q25 with a reference voltage generated by A2Q30 and A2VR17 is utilized. The

offset of the amplifier is adjusted by the DC OFFSET potentiometer, A2R27 and the T.C. temperature compensation is controlled by A2R25. A mV ZERO potentiometer, A2R2, is in series with A2R25 for finer adjustment. Protection on all ranges is provided by clamping diodes A2VR1 and A2VR2.

DC current measurement is selected by the mA pushbutton A2S3-B. This switch selects a string of current shunt resistors, A2R2 through A2R5 with ranges .1 mA, 1 mA, 10 mA, 100 mA, and 1000 mA. The .1 mA and 1 mA range use the same shunt string A2R2, A2R3, A2R4, and A2R5 (1 kΩ) with a change in the gain of the amplifier via A2S5-B for a .1 mA and A2S6-A for 1 mA. The voltage drop across the shunt is then measured as in DC volts.

5.4.2 AC TO DC CONVERTER (Schematic 37217-7-1 , Sheet 1 of 2)

The AC to DC Converter consists of a frequency compensated input attenuator, a wide band precision rectifier, and a full wave averager with a differential dc amplifier.

The frequency compensated input attenuator divides the ac input voltage by factors of 10, 100, or 1000 in the 10, 100, and 1000 volt ranges. No attenuation occurs in the .1 and 1 volt ranges. The switch selected precision voltage divider consists of resistors A2R107, A2R108, and A2R109 which are initially ratio matched to A2R110 within ±.05%. Each attenuator range is frequency compensated with fixed and adjustable trimmer capacitors. Trimmers, A2C49, A2C48, and A2C47 allow adjustment of the 10, 100, and 1000 ranges to compensate for capacitor tolerances and variation of stray capacitances. In the .1 and 1 ranges, 1 MΩ resistors A2R119 or A2R120 provide a dc return path to common for the noninverting input gate of the dual FET precision rectifier-amplifier, A2Q10.

The wide-band precision rectifier converts the ac input waveform into two pulsating dc components consisting of a positive half cycle and a negative half cycle. This rectifier circuit consists mainly of a dual FET differential amplifier, A2Q10 followed by a dual PNP transistor differential amplifier. This amplifier has high input impedance, high gain bandwidth product, and very low dc drift. Output transistors A2Q7 and A2Q8 provide low output impedance and rectification for the positive and negative signal components. The positive component is fed back to the inverting input of dual FET, A2Q10 via the frequency compensated feedback divider, A2R68, A2R70, and associated capacitors. Similarly, the negative component is fed back to the inverting input of dual FET, A2Q10 via the frequency compensated feedback divider, consisting of A2R69 and A2R70. Trimmer capacitor A2C32 adjusts the output vs frequency characteristic of the precision rectifier section, and should be adjusted for a flat characteristic on the .1 range. this one setting will also be adequate for the 1 range and should

be set before the attenuator compensation adjustments are made. Due to the extremely high feedback factor of the precision rectifier amplifier, its gain is essentially independent of the active components and is mainly determined by the feedback divider resistor ratios. Over-voltage protection is provided by Zener diodes A2VR10, A2VR8, A2VR6, and A2VR7.

The full wave averager and differential dc amplifier averages, amplifies, and filters the precision rectified positive and negative signal components. The ac scale factor settings are made by adjusting the dc gain of the amplifier, A2Q1 & A2U1. Since this amplifier is operated in a differential input mode, the dc output is a function of the absolute value of the positive and negative input dc components. Since the fundamental ac components of the two inputs are equal in amplitude and in phase, cancellation of the fundamental ac components and in-phase harmonics occurs in the amplifier. The positive half cycles are fed to the positive noninverting input of the amplifier and the negative half cycles are fed to the inverting input of the amplifier. Some gain is provided by A2R58 and A2R59 with feedback A2R57. Out of phase harmonics and noise are reduced by the RC filter sections, A2C31, A2R70, A269, A2C38, A2R68, A2C30, A2R67, and A2C25. This type of full wave averaging allows fast converter response since ripple reduction at low frequencies is achieved with relatively short RC filter time constants. The switched 5 volt supply is turned off, inhibiting the polarity indicator.

To measure ac current, the same set of precision current shunt resistors used in the dc current mode are utilized. This resistor string is switched across the input terminals to obtain full scale current readings from 0.1 mA to 1000 mA in decade steps. Since the voltage developed across the shunt resistor is directly proportional to the current through it, measurement of this voltage drop produces a readout in ac mA. The full scale voltage drop across the shunt resistors is 100 mV for the 0.1 mA range, and 1 V for all other ranges. Fuse A2F1 limits the current to 1.5 amps.

5.4.3 OHMS CIRCUIT (Schematic 37217-7-1 , Sheet 1 of 2)

The Ohms Circuit utilizes the main dc amplifier, A2U1 & A2Q1 and dc attenuator network with the -REF as the current source. The main amplifier is clamped by A2VR4 so that the open circuit voltage does not exceed ±13 volts.

The -REF, through a set of resistors A2R8 through R16, depending on the range selected, provides a select constant current to the summing junction of the dc amplifier. The unknown resistor, connected across the HI and LO input terminals, acts as the

5.4.3 OHMS CIRCUIT (Cont'd)

feedback resistor for the summing amplifier. Note since the -REF supply is used, the HI terminal is negative with respect to the LO terminals. When measuring forward resistance of diodes, the anode should be connected to the LO terminal. The switched +5 V supply, +5 V SW, is turned off, inhibiting the polarity indicator.

5.4.4 ANALOG TO DIGITAL CONVERTER (Schematic 37217-7-1 Sheet 2 of 2)

This description includes the ± reference supplies, the integrator, and the zero detector.

The positive reference utilizes a 6.2 V precision Zener, A2VR5, and an operational amplifier A2U2. The output of +REF amplifier is +10 V dc adjusted by A2CR50. Additional jumpers may be utilized for A2R53 and A2R54 if the amplifier gain is not sufficient to deliver the full scale output voltage.

The negative reference, -REF, is generated by inverting the positive reference, +REF output. A unity gain, operational amplifier A2U3 is used as the inverter. Gain is adjustable with A2R36. The -REF is attenuated in the KΩ mode by a factor of one-half by switching R101. In this mode of operation, ±130 V can be applied to the instrument without damage. Since this -REF is connected across the output terminal, a voltage protection network consisting of A2Q26, A2CR18, and A2C17 is provided. A fuse is also provided for the 1 kΩ range which will blow at about 35 V.

The integrator consists of a FET input operational amplifier A2Q5 and A2U6. A clamp is provided across the integrating capacitor, A2C41, between each measurement cycle. The measurement cycle can be varied by the front panel SAMPLE RATE control. The input of the integrator is offset by A2R83 to correct for 16 counts delay which is provided at the end of the first measurement cycle. The clock is inhibited for 16 counts after the Full Scale pulse arrives.

The output of the integrator is fed into a voltage comparator A2U7. A2CR9 and A2CR10 at the input of the comparator are provided so the input is clamped to ± the diode drop. This improves the response of the comparator at zero crossover. The threshold (ZERO DET.) is adjustable through A2R71.

5.4.5 POWER SUPPLY (Schematic 37217-7-1 , Sheet 2 of 2)

+5 V Supply

The regulated +5 V supply consists of NPN power transistor A2Q28, 5.4 volt reference Zener A2VR3, and associated components. The circuit is a basic emitter follower type series regulator. The

output voltage is determined by the Zener reference voltage of A2VR3. A2VR3 is initially selected for a tolerance of ±.1 volt which eliminates the necessity for adjustment of the supply.

+17 V Supply

This supply uses an integrated circuit regulator, A2U4, with an external series-pass transistor, A2Q24, to increase the power handling capability and prevent warm-up voltage drift. A2U4 operates at a very low power dissipation and reaches thermal equilibrium rapidly. Since the internal voltage reference source is specified at ±5% tolerance, no adjustment of the supply voltage is necessary.

-18 V Supply

This supply is regulated by integrated circuit A2U5, and external pass transistor Q4. The operation and advantages of this circuit are similar to the +17 V supply.

+200 V Supply

This supply consists of a full wave bridge rectifier, A2CR1, A2CR19, A2CR20, and A2CR21, along with RC filter A2R129 and A2C3, and bleeder resistor A2R7. The output is an essentially unfiltered full wave rectified dc waveform to serve as the readout tube supply voltage. The pulsed operation permits reduced readout tube power dissipation and ensures long tube life.

CHAPTER 6

7004A FINAL ASSEMBLY PARTS LIST

Ref.	Description	Qty.	SD Part No.
	7004A Final Assembly		37190-4-1
	7004A Schematic		37190-7-1
5	Test Assembly	1	37197-4-1
7	Bottom Cover Assembly	1	45065-3
9	End Trim	4	39033
11	Top Trim	2	39859-3
13	Handle	2	33570-3
15	Front Trim	2	37230-6-1
17	Readout Window	1	37202-1-1
19	Trim Strip	1	37203-1-1
21	Foil Cal. Trim Strip	1	037719
23	Label	1	23456
25	Line Cord	1	W0076
26	Cover Mtg. Bracket	2	39857
27	Cover Top	1	33567-3
	100 V Assembly		37473-4-1
	BCD Option 05 Assembly		37218-4-1
	Battery Pack Option 09 Assembly		37219-4-1
	Front Cover Assembly		37229-4-1
	Test Probe Kit		37232-4-1
	Rack Mount Kit Single		45410-3
	Rack Mount Kit Dual		37492-8-1

A1 COUNT CHAIN & READOUT P.C. ASSEMBLY PARTS LIST

Ref.	Description	SD Part No.
A1	Count Chain & Readout P.C. Assembly	37215-4-1
	Count Chain & Readout Schematic	37215-7-1
C1	Capacitor, .01 µF, Disc	C0556
C2	Capacitor, .01 µF, Disc	C0556
C3	Capacitor, 100 µF, 10 V, Electro	C0660
C4	Capacitor, .002 µF, 500 V	C0328
C5	Capacitor, .05 µF, 100 V	C0672
C6	Capacitor, 100 µF, 25 V	C0832
C7	Capacitor, 330 pF, 500 V	C0898
C8	Capacitor, .0022 µF, 200 V	C0687
C9	Capacitor, .0022 µF, 200 V	C0687
C10	Capacitor, 330 pF, 500 V	C0898
C11	Capacitor, .01 µF, Disc	C0556
C12	Capacitor, .01 µF, Disc	C0556
C13	Capacitor, .01 µF, Disc	C0556
C14	Capacitor, .01 µF, Disc	C0556
C15	Capacitor, .01 µF, Disc	C0556
C16	Capacitor, .001 µF, 500 V	C0424
C17	Capacitor, .001 µF, 500 V	C0424
C18	Capacitor, 470 pF, 300 V	C0542
C19	Capacitor, .001 µF, 500 V	C0424
CR1	Diode, Light Emitting	CR0367
CR2	Diode, 1N4151	CR0150
CR3	Diode, 1N4151	CR0150
Q1	Transistor, 2N3638	Q0181
Q2	Transistor, 2N3569	Q0318
Q3	Transistor, 2N5831	26004021
Q4	Transistor, 2N5831	26004021
Q5	Transistor, 2N3694	26012660
Q6	Transistor, 2N3568	Q0180
Q7	Transistor, 2N5831	26004021
Q8	Transistor, 2N5831	26004021
Q9	Transistor, 2N5831	26004021
Q10	Transistor, 2N5831	26004021
Q11	Transistor, 2N5831	26004021
R1	Resistor, 150 Ω, 1/4 W, 5%	R0983
R2	Resistor, 39 Ω, 1/4 W, 5%	R1552
R3	Resistor, 33 k, 1 W, 5%	R1263
R4	Resistor, 33 k, 1 W, 5%	R1263
R5	Resistor, 33 k, 1 W, 5%	R1263

A1 COUNT CHAIN & READOUT P.C. ASSEMBLY PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
R6	Resistor, 33 k, 1 W, 5%	R1263
R7	Resistor, 33 k, 1 W, 5%	R1263
R8	Not Used	
R9	Not Used	
R10	Not Used	
R11	Not Used	
R12	Not Used	
R13	Resistor, 5.6 k, 1/4 W, 5%	R0821
R14	Resistor, 5.6 k, 1/4 W, 5%	R0821
R15	Resistor, 3.3 k, 1/4 W, 5%	R0742
R16	Resistor, 3.3 k, 1/4 W, 5%	R0742
R17	Resistor, 470 Ω, 1/4 W, 5%	R1044
R18	Resistor, 220 Ω, 1/4 W, 5%	R0760
R19	Resistor, 2 k, 1/4 W, 5%	R0734
R20	Resistor, 3.3 k, 1/4 W, 5%	R0742
R21	Resistor, 3.3 k, 1/4 W, 5%	R0742
R22	Resistor, 470 Ω, 1/4 W, 5%	R1044
R23	Resistor, 3.3 k, 1/4 W, 5%	R0742
R24	Resistor, 10 k, 1/4 W, 5%	R0766
R25	Resistor, 10 k, 1/4 W, 5%	R0766
R26	Resistor, 10 k, 1/4 W, 5%	R0766
R27	Resistor, 10 k, 1/4 W, 5%	R0766
R28	Resistor, 3 k, 1/4 W, 5%	R0711
R29	Resistor, 3 k, 1/4 W, 5%	R0711
R30	Resistor, 1.5 k, 1/4 W, 5%	R0783
R31	Resistor, 1 k, 1/4 W, 5%	R0765
R32	Resistor, 270 Ω, 1/4 W, 5%	R0694
R33	Resistor, 270 Ω, 1/4 W, 5%	R0694
R34	Resistor, 10 k, 1/4 W, 5%	R0766
R35	Resistor, 10 k, 1/4 W, 5%	R0766
R36	Resistor, 10 k, 1/4 W, 5%	R0766
R37	Resistor, 10 k, 1/4 W, 5%	R0766
R38	Resistor, 10 k, 1/4 W, 5%	R0766
R39	Resistor, 15 k, 1/4 W, 5%	R0728
U1	Integrated Circuit, SN7441AN	025730
U2	Integrated Circuit, SN7441AN	025730
U3	Integrated Circuit, SN7441AN	025730
U4	Integrated Circuit, SN7441AN	025730
U5	Integrated Circuit, SN74L73N	045200
U6	Integrated Circuit, SN74L75N	045201
U7	Integrated Circuit, SN74L75N	045201

A1 COUNT CHAIN & READOUT P.C. ASSEMBLY PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
U8	Integrated Circuit, SN74L75N	045201
U9	Integrated Circuit, SN74L75N	045201
U10	Integrated Circuit, SN74L90N	045202
U11	Integrated Circuit, SN74L90N	045202
U12	Integrated Circuit, SN74L90N	045202
U13	Integrated Circuit, SN74L90N	045202
U14	Integrated Circuit, SN7400N	019705
U15	Integrated Circuit, SN74L00N	025796
U16	Integrated Circuit, SN74L00N	025796
U17	Integrated Circuit, SN74L51N	025799
U18	Integrated Circuit, SN74L00N	025796
U19	Integrated Circuit, SN74L00N	025796
U20	Integrated Circuit, SN74L00N	025796
U21	Integrated Circuit, SN7493N	025715
U22	Integrated Circuit, SN74L20N	025798
U23	Integrated Circuit, SN74L00N	025796
U24	Integrated Circuit, SN74L04N	045204
U25	Integrated Circuit, SN74L00N	025796
V1	Tube, Readout	V0132
V2	Tube, Readout	V0132
V3	Tube, Readout	V0132
V4	Tube, Readout	V0132
V5	Tube, Readout	V0132
XV1	Socket Readout Tube	X0179
XV2	Socket Readout Tube	X0179
XV3	Socket Readout Tube	X0179
XV4	Socket Readout Tube	X0179
XV5	Socket Readout Tube	X0179
XU1	IC Socket	X0185
XU2	IC Socket	X0185
XU3	IC Socket	X0185
XU4	IC Socket	X0185
DS1	Lamp	I0050
	Tube Retainer Assembly	37206-4-1
	Minus Bracket Assembly	37235-4-1
J102	Connector, 30 Pin	J0504

A2 SWITCH P.C. ASSEMBLY PARTS LIST

Ref.	Description	SD Part No.
A2	Switch P.C. Board Assembly	37217-4-1
	Switch P.C. Schematic	37217-7-1
C1	Capacitor, .1 µF, 600 V	C0791
C2	Capacitor, 7100 µF, 10 V	C1188
C3	Capacitor, .22 µF, 600 V	03286700
C4	Capacitor, 500 µF, 50 V	C1243
C5	Capacitor, .047 µF, 600 V	C0793
C6	Capacitor, .047 µF, 600 V	C0793
C7	Capacitor, 100 pF, 500 V	C0536
C8	Capacitor, 500 µF, 50 V	C1243
C9	Capacitor, Factory Selected	Cxxxx
C10	Capacitor, .1 µF, 50 V	C0881
C11	Capacitor, 220 pF, 500 V	C0538
C12	Capacitor, .05 µF, 100 V	C0708
C13	Capacitor, 390 pF, 500 V	C0871
C14	Capacitor, .05 µF, 100 V	C0708
C15	Not Used	
C16	Capacitor, .05 µF, 100 V	C0708
C17	Capacitor, 390 pF, 500 V	C0871
C18	Capacitor, .1 µF, 50 V	C0881
C19	Capacitor, .05 µF, 100 V	C0708
C20	Capacitor, .1 µF, 200 V Met Myl.	C0382
C21	Capacitor, .05 µF, 100 V	C0708
C22	Capacitor, 100 pF, 500 V	C0536
C23	Capacitor, .1 µF, 200 V, Met. Myl.	C0382
C24	Capacitor, 390 pF, 500 V	C0871
C25	Capacitor, .1 µF, 200 V, Met Myl.	C0382
C26	Capacitor, .1 µF, 200 V, Met Myl.	C0382
C27	Capacitor, 390 pF, 500 V	C0871
C28	Capacitor, .05 µF, 100 V	C0708
C29	Capacitor, .05 µF, 100 V	C0708
C30	Capacitor, 33 pF, 500 V	C0531
C31	Capacitor, 5 pF, 500 V	C1071
C32	Capacitor, .8 - 8.5 pF, Trim	C1291
C33	Capacitor, .05 µF, 100 V	C0708
C34	Capacitor, 560 pF, 300 V	C0644
C35	Capacitor, .05 µF, 100 V	C0708
C36	Capacitor, .05 µF, 100 V	C0708
C37	Not Used	
C38	Capacitor, 33 pF, 500 V	C0531
C39	Not Used	

A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
C40	Capacitor, .05 µF, 100 V	C0708
C41	Capacitor, 1 µF, 50 V	C1272
C42	Capacitor, .01 µF, 100 V	C1295
C43	Capacitor, 1000 pF, 300 V	C1144
C44	Capacitor, .001 µF, D.M.	C0742
C45	Not Used	
C46	Not Used	
C47	Capacitor, .8 - 4.5 pF, Trim	03270200
C48	Capacitor, .8 - 4.5 pF, Trim	03270200
C49	Capacitor, .8 - 4.5 pF, Trim	03270200
C50	Capacitor, 10 pF, 500 V	C0527
C51	Capacitor, 10 pF, 500 V	C0527
C52	Capacitor, 68 pF, 500 V	C0635
C53	Capacitor, .05 µF, 100 V	C0708
C54	Capacitor, .1 µF, 1.2 kV	03286130
C55	Capacitor, .05 µF, 100 V	C0708
C56	Capacitor, .05 µF, 100 V	C0708
C57	Capacitor, Factory Selected	Cxxxx
CR1	Diode, 1N4005	CR0284
CR2	Diode, 1N4005	CR0284
CR3	Diode, 1N4005	CR0284
CR4	Diode, 1N4005	CR0284
CR5	Diode, 1N4005	CR0284
CR6	Diode, 1N4005	CR0284
CR7	Diode, 1N4005	CR0284
CR8	Diode, 1N4151	CR0150
CR9	Diode, 1N4151	CR0150
CR10	Diode, 1N4151	CR0150
CR11	Diode, 1N4151	CR0150
CR12	Diode, 1N4151	CR0150
CR13	Diode, 1N4151	CR0150
CR14	Diode, 1N4151	CR0150
CR15	Diode, 1N4005	CR0284
CR16	Diode, 1N4005	CR0284
CR17	Diode, 1N4005	CR0284
CR18	Diode, 1N4005	CR0284
CR19	Diode, 1N4005	CR0284
CR20	Diode, 1N4005	CR0284
CR21	Diode, 1N4005	CR0284

A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
F1	Fuse, 1-1/2 A	F0046
F2	Not Used	
F3	Fuse, 1/64 A, Pigtail	F0069
Q1	Transistor, Sμ2365A	Q0302
Q2	Transistor, 2N3638	Q0181
Q3	Not Used	
Q4	Transistor, 2N2905	Q0259
Q5	Transistor, Sμ2365A	Q0302
Q6	Transistor, 2N4023	26013950
Q7	Transistor, 2N3694	26012660
Q8	Transistor, 2N4917	26014620
Q9	Transistor, 2N3694	26012660
Q10	Transistor, Sμ2365A	Q0302
Q11	Transistor, 2N3694	26012660
Q12	Transistor, 2N4093	Q0301
Q13	Transistor, 2N4093	Q0301
Q14	Transistor, 2N4093	Q0301
Q15	Transistor, 2N4393	Q0316
Q16	Transistor, 2N3568	Q0180
Q17	Transistor, 2N3568	Q0180
Q18	Transistor, 2N3568	Q0180
Q19	Transistor, 2N3568	Q0180
Q20	Transistor, 2N3638	Q0181
Q21	Transistor, 2N3638	Q0181
Q22	Transistor, 2N3638	Q0181
Q23	Transistor, 2N3638	Q0181
Q24	Transistor, 2N3072	26008560
Q25	Transistor, 2N3694	26012660
Q26	Transistor, 2N3440	Q0319
Q27	Not Used	
Q28	Transistor, 2N6103	Q0317
Q29	Transistor, 2N3694	26012660
Q30	Transistor, 2N4250	26014430
R1	Resistor, Factory Selected	Rxxxx
R2	Resistor, 900 Ω,.1%,.3 W	R2807
R3	Resistor, 90 Ω, .1%, .3 W	R2808
R4	Resistor, 9 Ω, .1%, .3 W	R2809
R5	Resistor, 1 Ω, .1%, 5 W	R2810
R6	Not Used	
R7	Resistor, 560 k, 5%, 1/2 W	02031140
R8	Resistor, 8.87 M, 1%, 2 W	R2851

A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
R9	Resistor, 500 k, Potentiometer	R2847
R10	Resistor, 887 k, 1%, 1/4 W	R2848
R11	Resistor, 50 k, Potentiometer	R2783
R12	Resistor, 88.7 k, 1%, 1/4 W	R2845
R13	Resistor, 5 k, Potentiometer	01111360
R14	Resistor, 8.87 k, 1%, 1/4 W	R2840
R15	Resistor, 500 Ω, Potentiometer	R2821
R16	Resistor, 1 k, .05%, 1/4 W	R2832
R17	Resistor, 430 k, 5%, 1/2 W	R0276
R18	Resistor, 430 k, 5%, 1/2 W	R0276
R19	Resistor, 3.6 k, 5%, 1/4 W	R0938
R20	Resistor, 5.62 k, 1%, 1/8 W	R2837
R21	Resistor, 35.7 k, 1%, 1/4 W	R2853
R22	Resistor, 470 Ω, 5%, 1/4 W	R1044
R23	Resistor, 8.199 k, 1%, 1/4 W	R2839
R24	Resistor, 820 Ω, 5%, 1/4 W, Selected	Rxxxx
R25	Resistor, 1 k, Potentiometer	R2816
R26	Resistor, 35.7 k, 1%, 1/4 W	R2853
R27	Resistor, 50 Ω, Potentiometer	R2822
R28	Resistor, 10 k, 1%, 3 W	02421000
R29	Resistor, 330 Ω, 5%, 1/4 W	R0662
R30	Resistor, 5.6 Ω, 5%, 1/4 W	R2498
R31	Resistor, 15 k, 1%, 1/4 W	R2073
R32	Resistor, 2.2 k, 5%, 1/4 W	R0749
R33	Resistor, 1.5 k, 5%, 1/4 W	R0783
R34	Resistor, 1 M, 5%, 1/4 W	R0962
R35	Resistor, 10 k, 1%, 1/4 W	R2405
R36	Resistor, 500 Ω, Potentiometer	R2821
R37	Resistor, 3.74 k, 1%, 1/4 W	R2824
R38	Resistor, 3 k, 5%, 1/4 W	R0711
R39	Resistor, 3 k, 5%, 1/4 W	R0711
R40	Resistor, 100 Ω, 5%, 1/4 W	R0966
R41	Resistor, 100 Ω, 5%, 1/4 W	R0966
R42	Resistor, 50 k, Potentiometer	R2783
R43	Resistor, 976 k, 1%, 1/4 W	R2849
R44	Resistor, 10 k, 1%, 1/4 W	R2405
R45	Resistor, 2 k, 5%, 1/4 W	R0734
R46	Resistor, 5 k, Potentiometer	01111360
R47	Resistor, 88.7 k, 1%, 1/4 W	R2845
R48	Resistor, 5.03 k, 1%, 1/4 W	R2530

A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
R49	Resistor, 1 k, 5%, 1/4 W	R0765
R50	Resistor, 500 Ω, Potentiometer	R2821
R51	Resistor, 1.47 k, 1%, 1/4 W	R2833
R52	Resistor, 499 Ω, 1%, 1/4 W	R2831
R53	Resistor, 301 Ω, 1%, 1/4 W	R2830
R54	Resistor, 8.06 k, 1%, 1/4 W	R2570
R55	Resistor, 1 M, 1%, 1/4 W	R2371
R56	Resistor, 1 M, 1%, 1/4 W	R2371
R57	Resistor, 10 k, 1%, 1/4 W	R2405
R58	Resistor, 2.74 k, 1%, 1/4 W	R1981
R59	Resistor, 200 Ω, Potentiometer	R2722
R60	Resistor, 1 M, 1%, 1/4 W	R2371
R61	Resistor, 1 M, 1%, 1/4 W	R2371
R62	Resistor, 221 Ω, 1%, 1/4 W	R2829
R63	Resistor, 20 Ω, Potentiometer	R2784
R64	Resistor, 35.7 k, 1%, 1/4 W	R2853
R65	Not Used	
R66	Resistor, 1 k, 5%, 1/4 W	R0765
R67	Resistor, 1 k, 5%, 1/4 W	R0765
R68	Resistor, 49.9 k, 1%, 1/4 W	R2844
R69	Resistor, 49.9 k, 1%, 1/4 W	R2844
R70	Resistor, 100 k, 1%, 1/4 W	R2846
R71	Resistor, 50 k, Potentiometer	R2783
R72	Resistor, 35.7 k, 1%, 1/4 W	R2853
R73	Resistor, 1 k, 5%, 1/4 W	R0765
R74	Resistor, 1 k, 5%, 1/4 W	R0765
R75	Resistor, 1 M, 5%, 1/4 W	R0962
R76	Resistor, 4.7 k, 5%, 1/4 W	R0892
R77	Resistor, 220 k, 5%, 1/4 W	R0967
R78	Resistor, 270 Ω, 5%, 1/4 W	R0694
R79	Resistor, 1.62 k, 1%, 1/4 W	R2834
R80	Resistor, 3.16 k, 1%, 1/4 W	R2836
R81	Resistor, 220 k, 5%, 1/4 W	R0967
R82	Resistor, 1 M, 5%, 1/4 W	R0962
R83	Resistor, 2 k, Potentiometer	R2721
R84	Resistor, 50 Ω, Potentiometer	R2822
R85	Resistor, 35.7 k, 1%, 1/4 W	R2853
R86	Resistor, 35.7 k, 1%, 1/4 W	R2853
R87	Resistor, 4.7 k, 5%, 1/4 W	R0892
R88	Resistor, 6.19 k, 1%, 1/4 W	R2838

A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

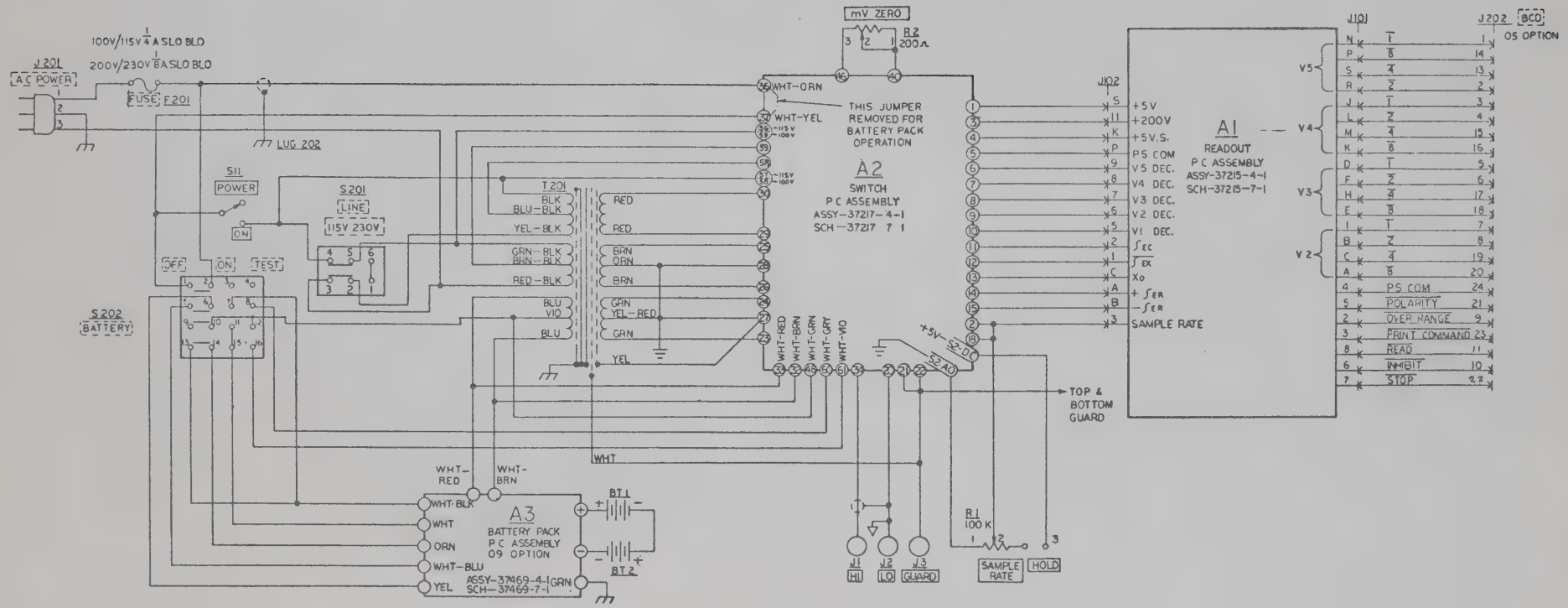
Ref.	Description	SD Part No.
R89	Resistor, 15.8 k, 1%, 1/4 W	R2878
R90	Resistor, 3.3 k, 5%, 1/4 W	R0742
R91	Resistor, 100 k, 5%, 1/4 W	R0741
R92	Resistor, 100 k, 5%, 1/4 W	R0741
R93	Resistor, 100 k, 5%, 1/4 W	R0741
R94	Resistor, 100 k, 5%, 1/4 W	R0741
R95	Resistor, 20 k, 1%, 1/2 W	02379680
R96	Resistor, 100 Ω, 1%, 1/4 W	R2620
R97	Resistor, 10 k, 5%, 1/4 W	R0766
R98	Resistor, 10 k, 5%, 1/4 W	R0766
R99	Resistor, 10 k, 5%, 1/4 W	R0766
R100	Resistor, 10 k, 5%, 1/4 W	R0766
R101	Resistor, 10 k, 5%, 1/4 W	R0766
R102	Resistor, 10 k, 5%, 1/4 W	R0766
R103	Resistor, 10 k, 5%, 1/4 W	R0766
R104	Resistor, 10 k, 5%, 1/4 W	R0766
R105	Resistor, 10 k, 5%, 1/4 W	R0766
R106	Resistor, 15.8 k, 1%, 1/4 W	R2878
R107	Resistor, 1.0010 k, Part of Set	37225-6-1
R108	Resistor, 10.101 k, Part of Set	37225-6-1
R109	Resistor, 111.11 k, Part of Set	37225-6-1
R110	Resistor, 1 M, Part of Set	37225-6-1
R111	Resistor, 560 Ω, 5%, 1/4 W	R0819
R112	Resistor, 10 k, 5%, 1/4 W	R0766
R113	Resistor, 100 Ω, 5%, 1/4 W	R0966
R114	Resistor, 1 k, 5%, 1/4 W	R0765
R115	Resistor, 3.3 k, 5%, 1/4 W	R0742
R116	Resistor, 3.3 k, 5%, 1/4 W	R0742
R117	Resistor, 3.3 k, 5%, 1/4 W	R0742
R118	Resistor, 3.3 k, 5%, 1/4 W	R0742
R119	Resistor, 1 M, 1%, 1/2 W	02381310
R120	Resistor, 1 M, 1%, 1/2 W	02381310
R121	Not Used	
R122	Resistor, 100 Ω, 1%, 1/4 W	R2620
R123	Resistor, 820 Ω, 5%, 1/4 W	R0762
R124	Not Used	
R125	Resistor, 15 k, 5%, 1/4 W	R0728
R126	Resistor, 15 k, 5%, 1/4 W	R0728
R127	Resistor, 15 k, 5%, 1/4 W	R0728
R128	Resistor, 15 k, 5%, 1/4 W	R0728
R129	Resistor, 1 k, 5%, 1/4 W	R0765

A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

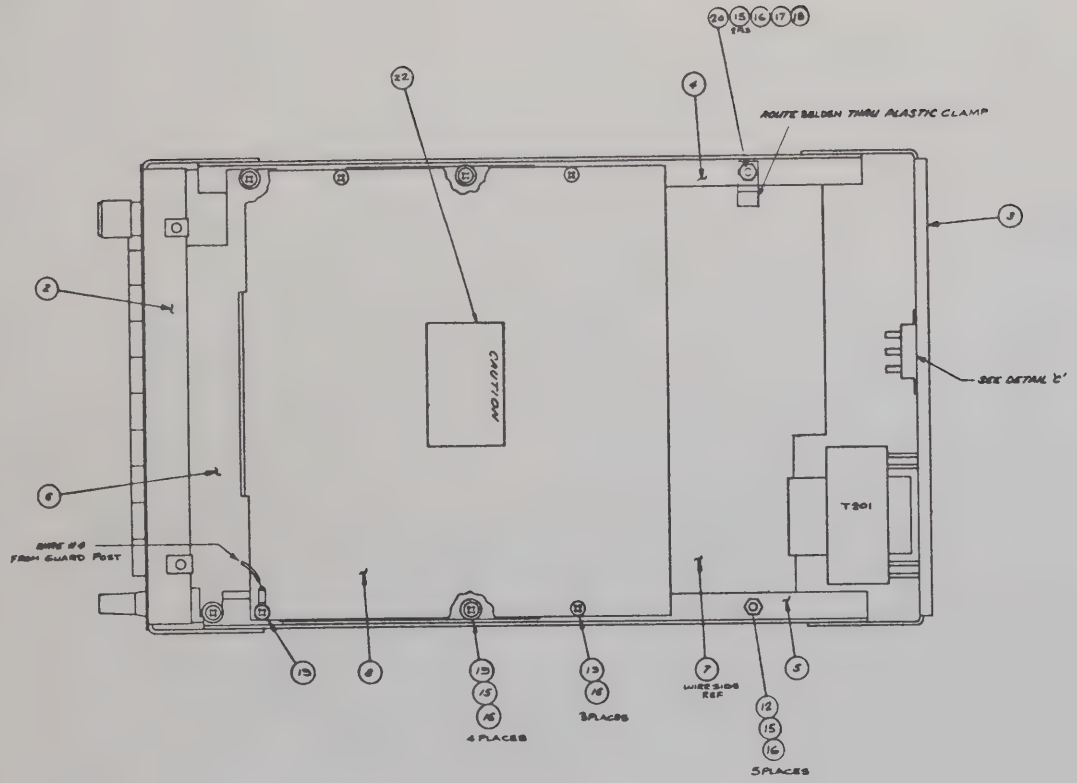
Ref.	Description	SD Part No.
R130	Resistor, 100 Ω, 5%, 1/4 W	R0966
R131	Resistor, 15.8 k, 1%, 1/4 W	R2878
R132	Resistor, 50 Ω, Potentiometer	R2822
R133	Resistor, 10 k, 5%, 1/4 W	R0766
R134	Resistor, 1 k, 5%, 1/4 W	R0765
R135	Resistor, 3.01 k, 1%, 1/4 W	R2338
S1	Switch, Push-button	037721
S2	Switch, Push-button	037721
S3	Switch, Push-button	037721
S4	Switch, Push-button	037721
S5	Switch, Push-button	037721
S6	Switch, Push-button	037721
S7	Switch, Push-button	037721
S8	Switch, Push-button	037721
S9	Switch, Push-button	037721
S10	Switch, Push-button	037721
TP1	Test Point, Brown	E0235
TP2	Test Point, Black	E0234
TP3	Test Point, Orange	E0237
TP4	Test Point, Yellow	E0238
TP5	Test Point, Green	E0239
TP6	Test Point, Blue	E0240
TP7	Test Point, Violet	E0241
TP8	Test Point, Grey	E0242
U1	Integrated Circuit, LM301A	025745
U2	Integrated Circuit, LM301A	025745
U3	Integrated Circuit, LM301A	025745
U4	Integrated Circuit, µA723	025761
U5	Integrated Circuit, µA723	025761
U6	Integrated Circuit, LM301A	025745
U7	Integrated Circuit, LM311	025792
VR1	Diode Zener, FZ902	26015850
VR2	Diode Zener, FZ902	26015850
VR3	Diode Zener, Selected 2N3640	37486
VR4	Diode Zener, 1N959B	CR0346
VR5	Diode Zener, 1N827	CR0162
VR6	Diode Zener, FZ902	26015850
VR7	Diode Zener, FZ902	26015850
VR8	Diode Zener, FZ902	26015850
VR9	Not Used	

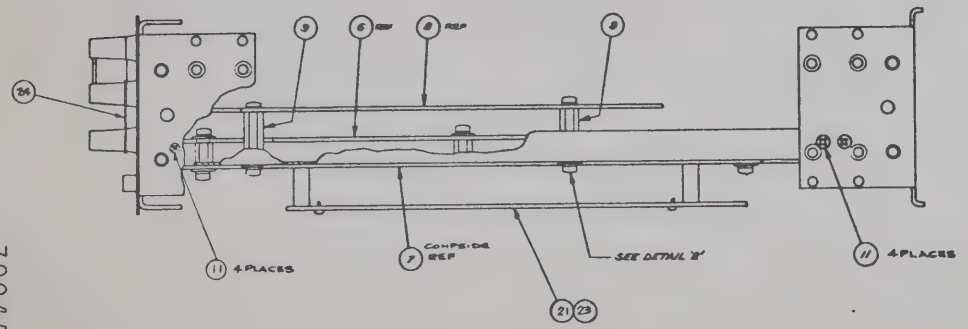
A2 SWITCH P.C. ASSEMBLY PARTS LIST (Cont'd)

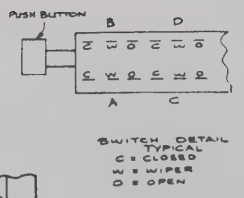
Ref.	Description	SD Part No.
VR10	Diode Zener, FZ902	26015850
VR11	Diode Zener, 1N753A	CR0163
VR12	Diode Zener, 1N963B	CR0174
VR13	Not Used	
VR14	Diode Zener, FZ902	26015850
VR15	Diode Zener, 1N963B	CR0174
VR16	Diode Zener, 1N968B	CR0265
VR17	Diode Zener, 2N3640, Selected	37591
	Terminal, Insulated	51024460
	Heat Sink	H2050
	Transistor Pad	H0515
	I.C. Socket (U4 & U5)	X0184
	I.C. Insulator (U4 & U5)	39466-04



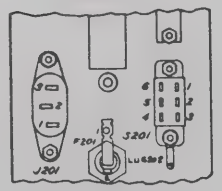
MODEL 7004A, BLOCK DIAGRAM #37190-7-1D

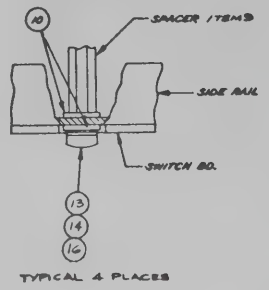






SWITCH DETAIL
TYPICAL
C = CLOSED
W = WIPER
O = OPEN





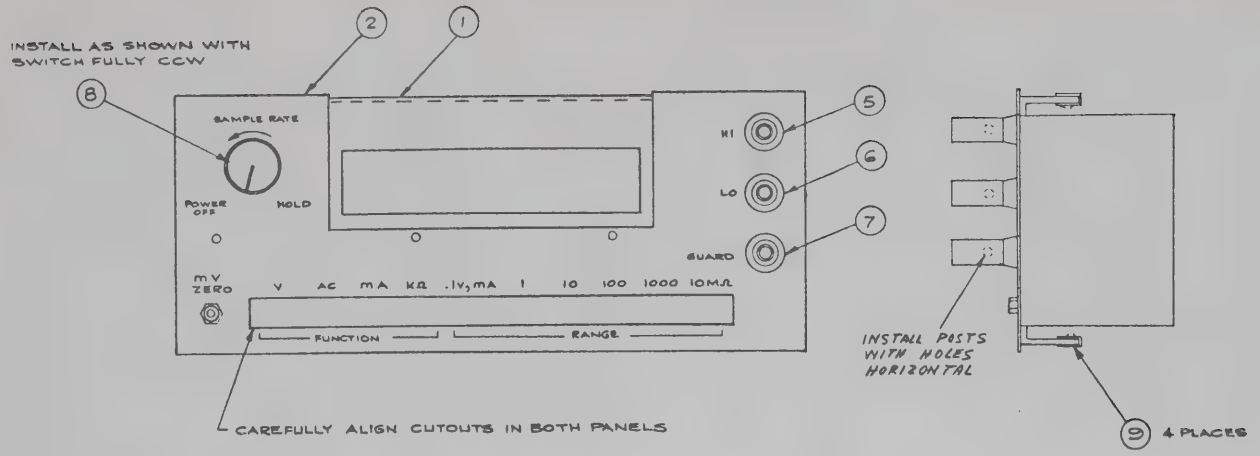
FRONT PANEL HOOKUP				
WIRE	COLOR	FROM	TO	
1 BELDEN	RED	S11-1	A2-37	
	BLK	S11-2	S201-4	
	SHIELD	—	LUG 202	
2 COAX	INNER	J1	A2 / A4	
	SHIELD	J2	A2 / A3	SEE DETAIL
3	B	J3	A2-21	
4	B	J3	GUARD-COVER TOP	
5	O	R1-1	A2 / A40	SWITCH SEE DETAIL
6	95	R1-2	A2-10	
7	2	R1-3	A2 / A2-DC	SWITCH SEE DETAIL
R2 MV 2640	YEL	R2-1	A2-40	
	RED	R2-2	A2-40	
	GRN	R2-3	A2-46	
FROM A2 301	2	A2-3	P201-2	
FROM A2 202	9	A2-56	S201-5	
FROM A2 202	90	A2-57	S201-4	

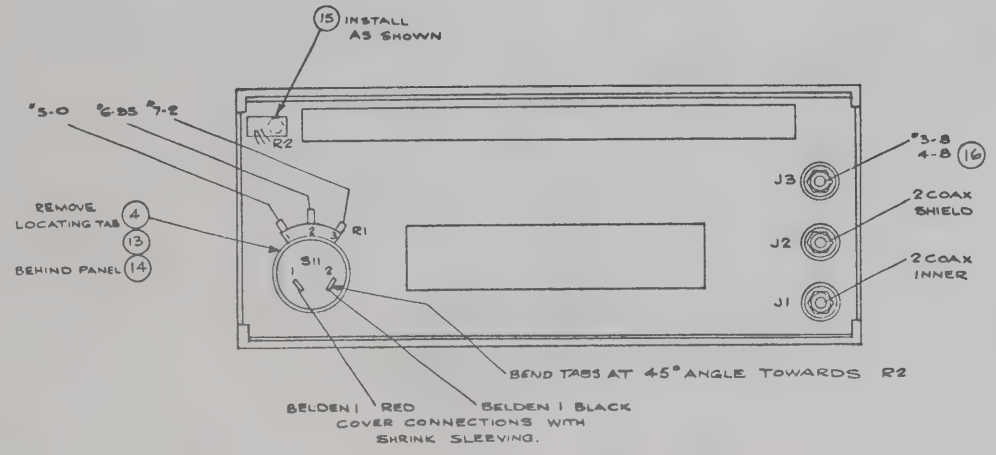
T201 HOOKUP			
BLU	A2-32	RED	A2-30
BLU	A2-33	RED	A2-29
BRN	A2-25		
BRN	A2-26	BLK	A2-57
ORN	A2-28	BLU/BLK	A2-58
GRN	A2-24	BRN/BLK	A2-55
GRN	A2-23	GRN/BLK	A2-56
YEL/RED	A2-27	VIO	A2-48
WHT	A2-22	CONNECT J102 FROM A1 TO A2	

YEL 8

26				
24	1	E-OBIT	SHORTING LINK	
23	4	H0287	SCREW 6-32 X 5/16 FL. HD	
22	1	37471-6-1	CAUTION LABEL	
21	1	37214-4-1	ASSY. GUARD COVER BOTTOM	
20	1	H0288	SCREW 6-32 X 1/2 PAN HD	
19	8	H0986	SCREW 4-40 X 1/4 PAN HD	
18	1	H0380	NUT HEX 6-32	
17	1	H0788	CABLE CLAMP	
16	13	H0783	WASHER, #6 SPLIT	
15	11	H0759	WASHER, #6 FLAT	
14	4	H0484	WASHER #6 SMALL FLAT	
13	4	H1637	SCREW, 5-32 X 7/8 PAN HD.	
12	5	H1281	SCREW, 6-32 X 3/16 FAN HD	
11	8	H1730	SCREW 4-40 X 3/16 FLAT HD.	
10	8	624070020	WASHER, #6 SHOULDER	
9	4	H0612	SPACER, 6-32 X 3/8	
8	1	37210-1-1	GUARD COVER, TOP	
7	1	37464-4-1	ASSY. SWITCH BD & CABLE	
6	1	37215-4-1	ASSY REACUT PC BD	A1
5	1	37209-1-1	SIDE RAIL, RIGHT HAND	
4	1	37207-1-1	SIDE RAIL, LEFT HAND	
3	1	37211-4-1	ASSY, REAR PANEL	
2	1	37198-4-1	ASSY, FRONT PANEL	
1	REF	37190-7-1	SCHEMATIC, 7004	
ITEM NO.	QTY	PART NO.	DESCRIPTION	CHANGE OR NO.

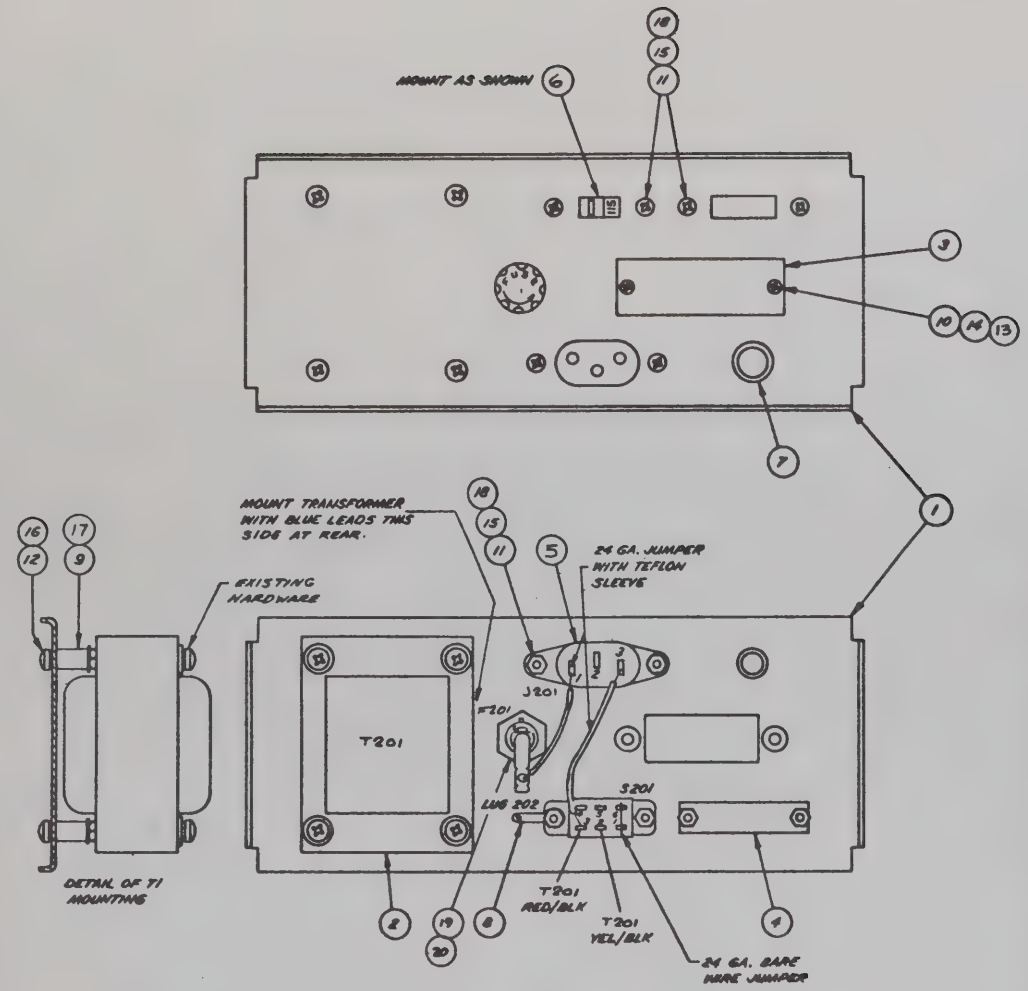
MODEL 7004A TEST ASSEMBLY #37197-4-1F





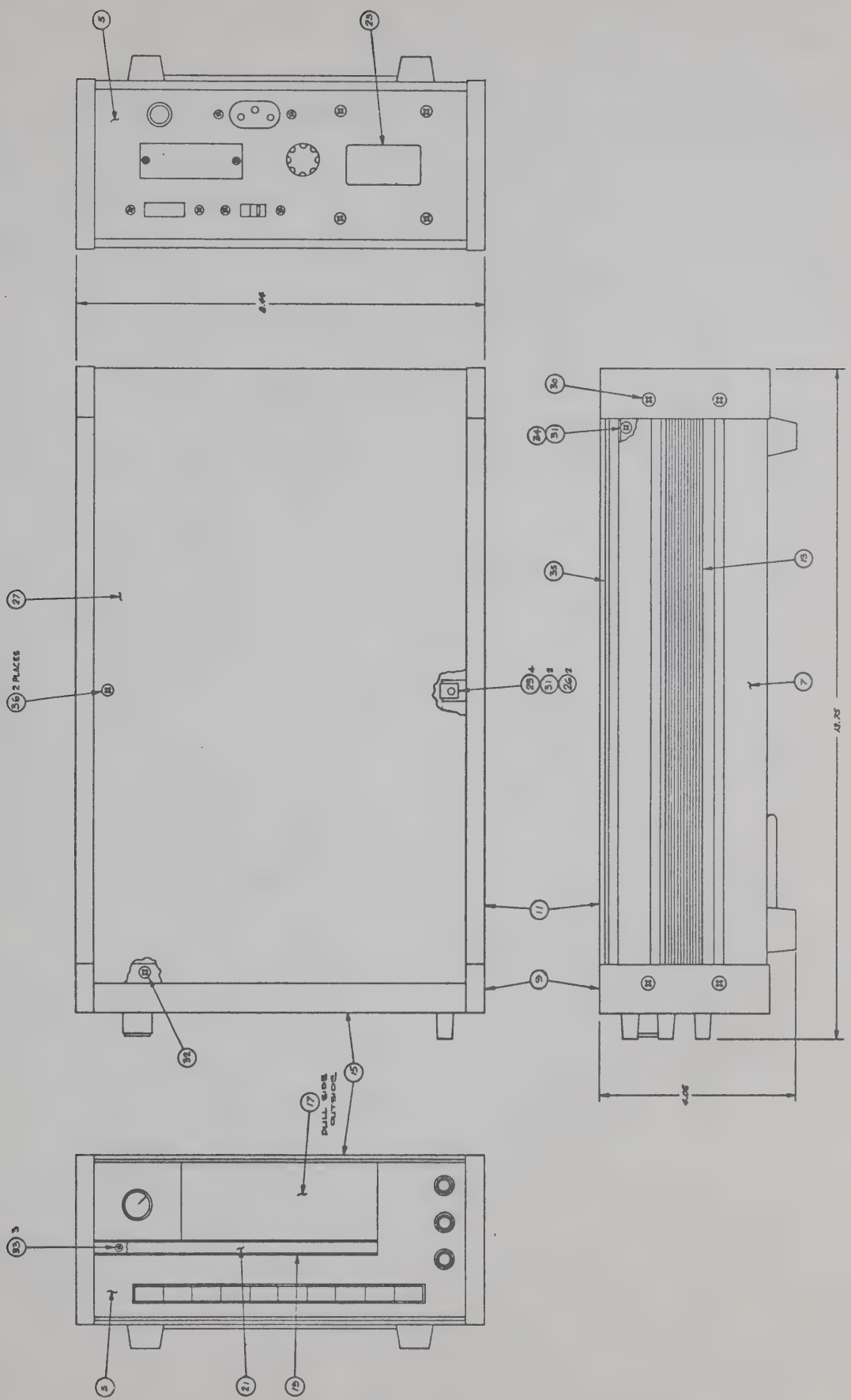
ITEM NO	QTY	PART NUMBER	DESCRIPTION	SCHEMATIC REF NO
16	1	E0118	SOLDER LUG #6	PART OF ITEM 3
15	1	R2828	POT 200Ω	R2
14	1	H0507	WASHER 3/8 INT. TOOTH	
13	1	H0466	NUT HEX 3/8-32	
12				
11				
10				
9	4	H1692	TINNERMAN NUT 6-32	
8	1	H1937	KNOB 1/4 SHAFT	
7	1	09064490	BINDING POST WHITE	J3
6	1	09064480	BINDING POST BLACK	J2
5	1	09064470	BINDING POST RED	J1
4	1	R2823	100K POT & SWITCH	R1 / S11
3	1	37198-5-1	WIRE LIST	
2	1	37201-6-1	FRONT PANEL DECORATIVE	
1	1	37199-1-1	FRONT SUB PANEL	

MODEL 7004A FRONT PANEL ASSEMBLY #37198-4-1B

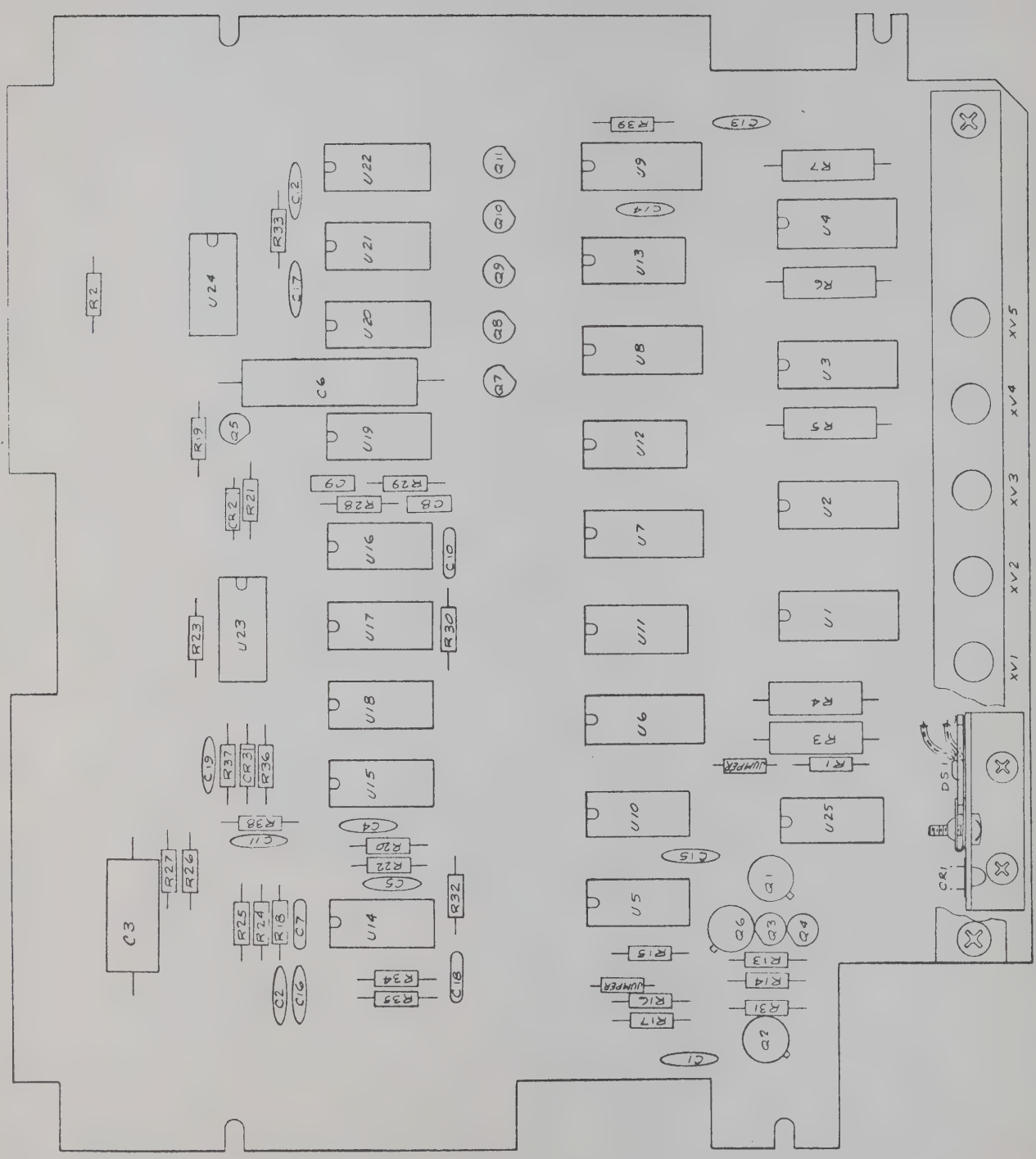


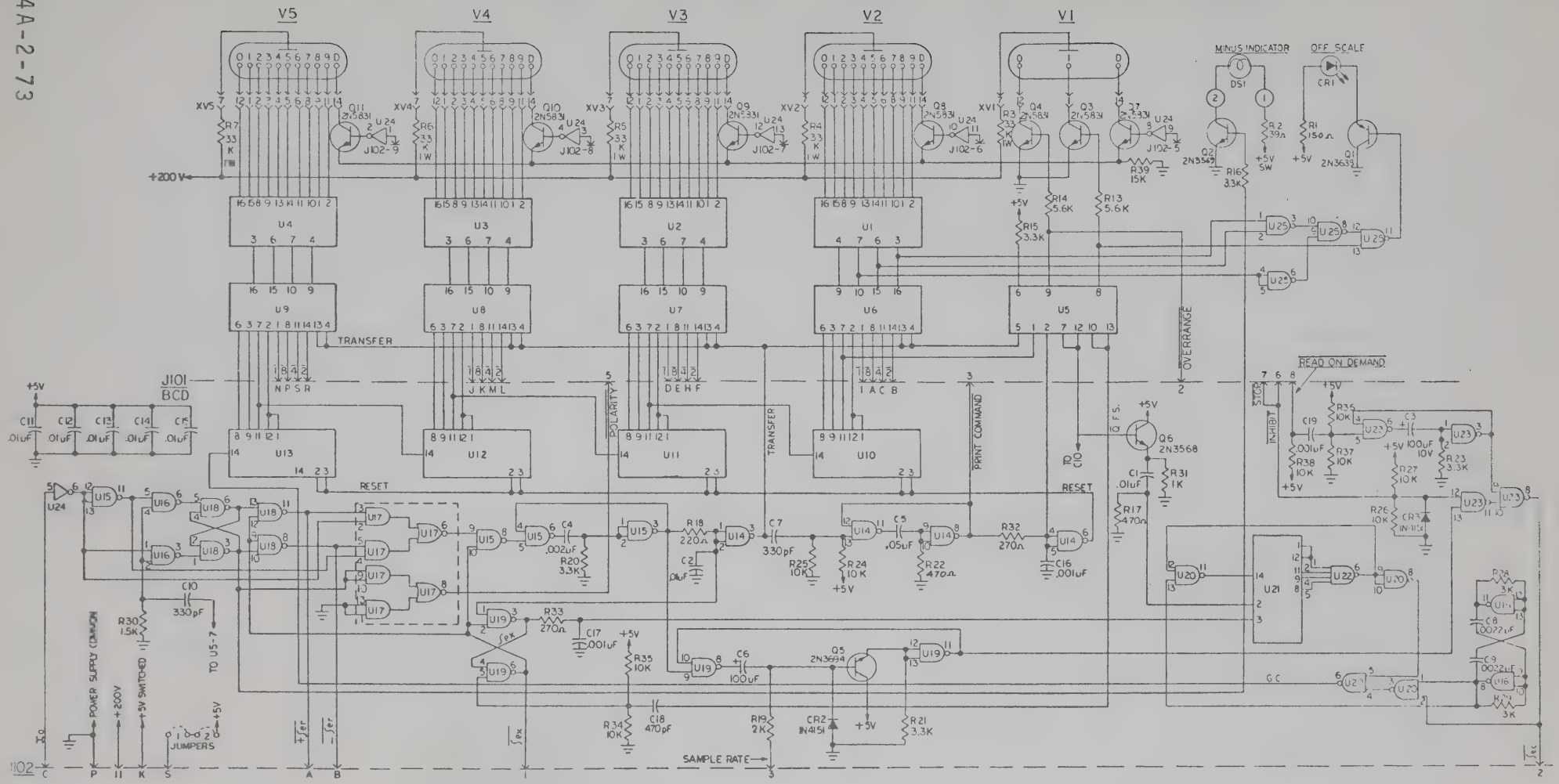
20	1	F-0077	FUSE, .3A SLO BLO 3AG	F201
19	1	X-0034	FUSE SOCKET	
18	6	H0249	NUT, 4-40 HEX	
17	4	H0759	WASHER, #6 FLAT	
16	4	H0783	WASHER, #6 SPLIT LOCK	
15	6	H0782	WASHER, #4 SPLIT LOCK	
14	1	H0481	WASHER #2 SPLIT LOCK	
13	1	H0138	WASHER #2 FLAT	
12	4	H0986	SCREW, 6-32 x 1/4 P HD	
11	6	H1273	SCREW, 4-40 x 5/16 P HD	
10	2	H1275	SCREW, 2-56 x 5/16 P HD	
9	4	E0225	SPACER, 6-32 x 1/2	
8	1	H0539	SOLDER LUG, 4-40	LUG 202
7	1	H1244	GROMMET, 3/8 DIA.	
6	1	S0384	SWITCH, 115/230	S201
5	1	J0566	SOCKET	J201
4	1	31399-1-1	COVER PLATE	
3	1	31418-1-1	COVER PLATE	
2	1	37470-6-1	TRANSFORMER SPEC	T201
1	1	C37211-1-1	REAR PANEL	
FIND NO.	QTY.	PART NUMBER	DESCRIPTION	SCHEMATIC REF. NO.

MODEL 7004A REAR PANEL ASSEMBLY #37211-4-1F



MODEL 7004A FINAL ASSEMBLY #37190-4-1B


A1, COUNT CHAIN & READOUT P.C. ASSEMBLY #37215-4-1D

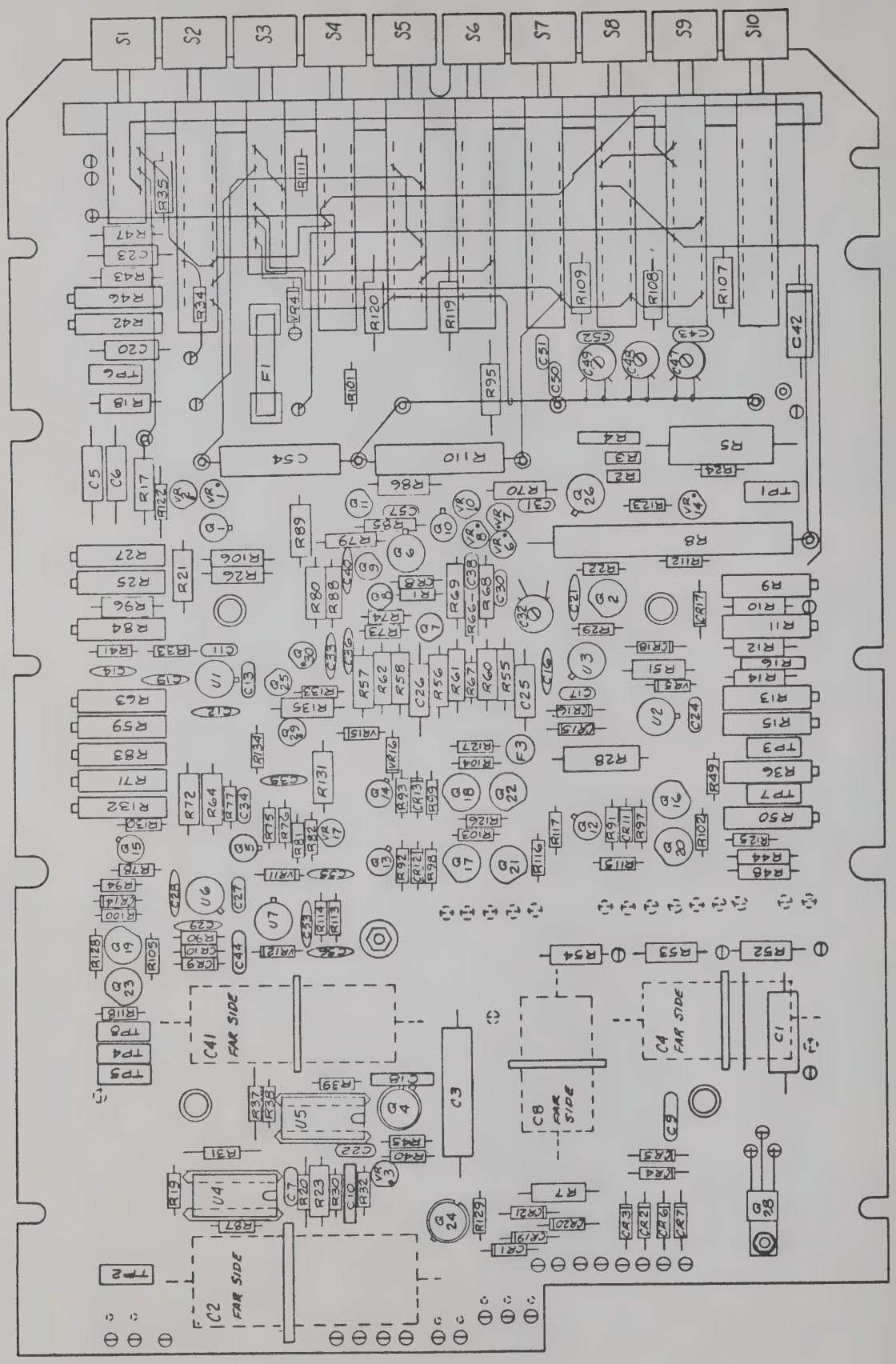


NOTE

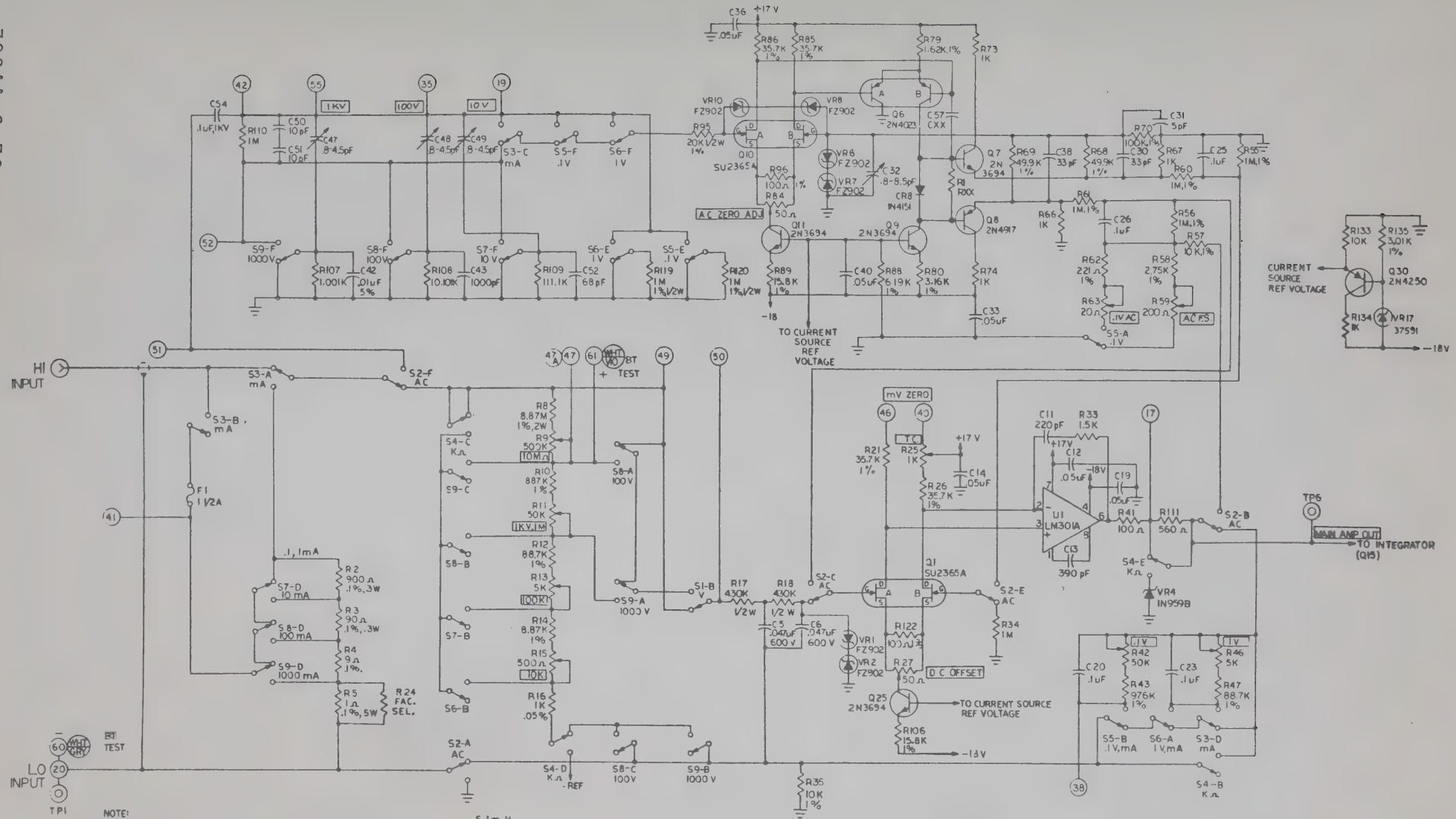
1. ALL RESISTORS 1/4 W UNLESS OTHERWISE SPECIFIED.

U	TYPE	GND PIN	+5V PIN
1,2,3,4	SN7441AN	12	5
5	SN74L73N	11	3,4,14
6,7,8,9	SN74L??N	12	5
10,11,12,13	SN74L20N	6,7,10	5
14	SN74L??N	7	14
15,16,18,19,20,23,25	SN74L00N	7	14
17	SN74L51N	1,7,13	14
21	SN7493N	10	5
22	SN74L20N	7,9,10,12,13	14
24	SN74L04N	7	14

A1, COUNT CHAIN & READOUT SCHEMATIC #37215-7-1D



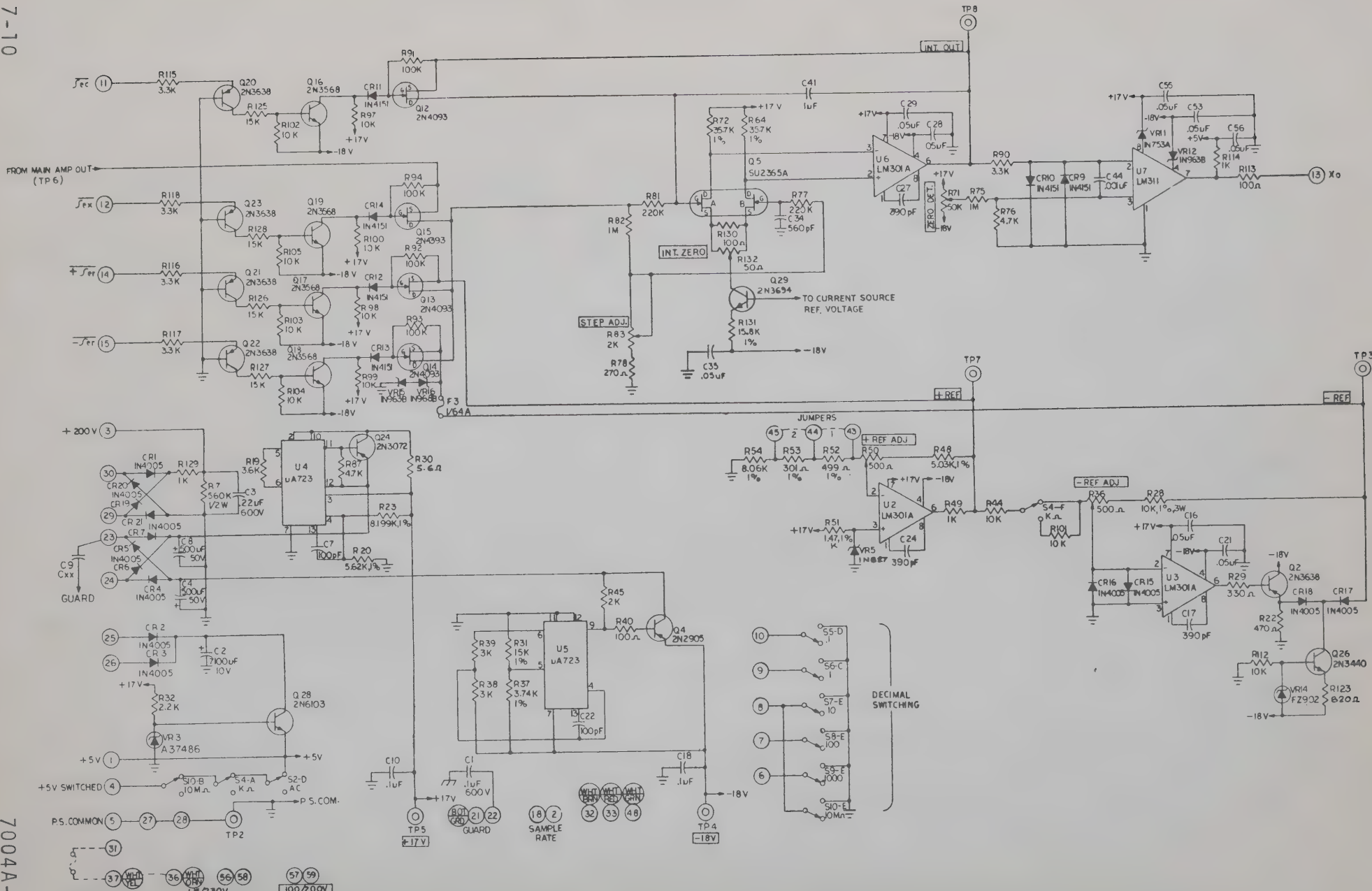
A2, SWITCH P.C. ASSEMBLY #37217-4-1G



NOTE:
1. UNLESS SPECIFIED RESISTORS ARE 5%, 1/4W.
2. R107, R108 & R109 ARE MATCHED TO R110 WITHIN .05%.
3. SWITCHES SHOWN IN 'OUT' POSITION.

S1 = V
S2 = AC
S3 = mA
S4 = KΩ
S5 = .1V, mA
S6 = 1
S7 = 10
S8 = 100
S9 = 1000
S10 = 10MΩ

A2, SWITCH BOARD SCHEMATIC #37217-7-1F (Sheet 1 of 2)



A2, SWITCH BOARD SCHEMATIC #37217-7-1F (Sheet 2 of 2)

CHAPTER 8
OPTIONS AND ACCESSORIES

8.1 INTRODUCTION

This chapter contains descriptions of the standard options and accessories available for the Model 7004A Digital Multimeter. The two options described in this chapter are Option 05, Digital Outputs and Option 09, Battery Pack. The accessories include the three foot, color coded input test leads, the single rack mount kit, the dual rack mount kit, and the protective front panel snap cover.

8.2 OPTION 05, DIGITAL OUTPUTS (BCD)

This option provides non-isolated 1-2-4-8 BCD outputs and recorder control signals with DTL/TTL compatible logic levels. The input signal LOW and the BCD PS COMMON are tied together through a low internal impedance. Some degradation of common mode voltage and noise rejection should be anticipated when connected to an unbuffered or non-isolated recording device. Note: the outputs are not short circuit proof.

The outputs on J202, rear panel connector (AMPHENOL #57-40240) provide four BCD digits, V2 (10^3), V3 (10^2), V4 (10^1), and V5 (10^0) with one line (true) each for OVERRANGE, MINUS POLARITY, and PRINT COMMAND. Binary "0" or "False" is greater than +2.4 volts with a 200 µA source. The binary "1" or "True" is 0 to +0.5 volts with a 8 mA sink.

The inputs on J202 are all single lines with the "false" state accepting ground true logic. The external READ ON COMMAND line produces a single measurement per command. The INHIBIT line and the STOP line inhibit or complete the measurement cycle.

TABLE 8-1 BCD PIN ASSIGNMENTS

J202 PIN	5103 J2	FUNCTION
7	7	$\overline{1}$
8	8	$\overline{2}$ — V2 (10^3)
19	32	$\overline{4}$
20	33	$\overline{8}$
5	5	$\overline{1}$
6	6	$\overline{2}$ — V3 (10^2)
17	30	$\overline{4}$
18	31	$\overline{8}$

TABLE 8-1 BCD PIN ASSIGNMENTS (Cont'd)

J202 PIN	5103 J2	FUNCTION
3	3	$\overline{1}$
4	4	$\overline{2}$ — V4 (10^1)
15	28	$\overline{4}$
16	29	$\overline{8}$
1	1	$\overline{1}$
2	2	$\overline{2}$ — V5 (10^0)
13	26	$\overline{4}$
14	27	$\overline{8}$
24	49,50	$\overline{\text{PS COMMON}}$
21	21	$\overline{\text{MINUS POLARITY}}$
9	9	$\overline{\text{OVERRANGE}}$
23	48	$\overline{\text{PRINT COMMAND}}$
11	N.C.	$\overline{\text{READ ON COMMAND}}$
22	49,50 switched	$\overline{\text{STOP}}$
10	47	$\overline{\text{INHIBIT}}$

Notes:

1. Grounds in Model 5103 must be isolated.
2. Negative readings are printed in red.

8.3 OPTION 09, BATTERY PACK

The Option 09 Battery Pack allows operation of the Model 7004A Multimeter for up to six hours from the self contained storage batteries before necessary re-charging. The Battery Pack circuitry has two major sections, a dc to ac inverter and an automatic battery charger. (Note: install fuse A3F1 on inverter board.)

8.3.1 DC TO AC INVERTER (SCHEMATIC 37469-7-1)

The dc to ac inverter circuit is a current limited, short circuit proof, driven inverter providing high efficiency power conversion and reliable operation. Excessive load current drain on any transformer winding due to another circuit failure or an inadvertant short circuit will not damage the inverter. Conventional square wave inverter operation is not used. Instead, each driver transistor conducts only 25% of the duty cycle, which produces a square wave when full wave rectified. This technique permits reliable operation of the readout tubes at reduced power levels from that required for conventional dc operation. Operating the tubes on a pulsed basis also allows high peak currents to prevent partial number glow due to cathode sublimation after long service life while still permitting low average power consumption.

The 25% duty cycle waveforms with 180° phase displacement drive the push-pull inverter power transistors, A3Q3 & Q3Q4. These waveforms are derived from a square wave clock generator, A3U1, followed by a two stage ripple counter composed of a dual J-K flip-flop A3U2 and appropriate logic circuitry A3U1. The basic square wave clock frequency is approximately 400 Hz producing an inverter drive frequency of 100 Hz, non-square wave.

Current limiting and overload protection is provided in this circuit. Since normal current levels through A3R7 will not develop sufficient voltage to exceed the base-emitter turn-on threshold voltage, A3Q1 is normally off. If an output overload causes excessive conduction through power transistors A3Q3 and A3Q4, the voltage developed across A3R7 will increase and turn on A3Q1. The drive current is then shunted from the bases of the power transistors, thereby limiting the current they deliver. In the event of an inverter malfunction, further protection is provided by Fuse A3F1. An output load short will not blow A3F1, however; when the inverter is functioning properly, since the battery current drain is limited by the action of A3Q1.

A3Q6, A3CR8, and A3Q7 with associated components perform the dual function of regulating the +5 V logic voltage and serve as an electronic power switch to turn the inverter drive on or off depending on whether BATTERY or LINE operation has been selected.

8.3.2 AUTOMATIC BATTERY CHARGER

The charger circuit is automatic and is connected to the battery when the instrument is operated on the power line. This circuit will provide a constant current charge to a discharged battery until it reaches a full charge condition. At the full charge condition the current tapers off to provide a constant FLOAT voltage of 13.7 to 13.8 V which is the ideal standby condition for maximum battery life. Since the FLOAT voltage is very accurately maintained, the battery remains fully charged. A completely discharged battery requires approximately 16 hours to recharge.

The charger circuit consists of an integrated circuit voltage regulator A3U3, power transistor A3Q8, current sensing resistor A3R16, voltage sensing resistor divider A3R17, A3R18, and FLOAT voltage adjustment potentiometer A3R19. The same transformer winding driven by the inverter circuit in battery operation is utilized as a charger voltage supply when the instrument is operated from the ac power lines. A full wave bridge rectifier A3CR1, A3CR2, A3CR3, and A3CR4 supplies an unfiltered dc input to the regulator circuit. Current limited pulses are fed to the battery through rectifier A3CR7 when the battery is charging. Constant voltage amplitude pulses are applied through A3CR7 when the battery charge condition is high enough so the current drawn does not produce current limiting in the regulator.

The battery FLOAT voltage is set at 13.7 to 13.8 volts at the factory and should normally not require attention. If readjustment of the FLOAT voltage should be required substitute a large electrolytic capacitor of at least 5,000 mF paralleled with a 10 k resistor for the battery. Monitor the voltage across the capacitor with the DMM and adjust the voltage to 13.7-13.8 V. This adjustment is very difficult to perform in any reasonable period of time with a battery connected to the charger.

The BATTERY TEST position on the rear panel slide switch S202 operates the instrument on its own internal batteries and displays the battery voltage under normal load on the readout. The end-of-life battery voltage is approximately 11 volts. Normal full charge voltage will be in excess of 12.5 volts under load. The instrument should be on the 10 VDC range and function with nothing connected to the input terminals when BATTERY TEST is operated. If the battery voltage will not operate the instrument, the battery voltage may be measured directly across the input terminals using a very high impedance volt meter. Approximately 9 megohms resistance is in series between the battery + terminal and the input HIGH terminal to prevent damage to the internal battery or an external source, so loading error must be considered when using an external meter.

8.4 ACCESSORIES

The acessories available for the Model 7004A Digital Multimeter include a set of input test leads, a single rack mount kit, a dual rack mount kit, and a protective front panel snap cover.

8.4.1 INPUT TEST LEADS (P/N 37232-4-1)

The input test leads accessory includes two 35 inch test leads. The black lead is an alligator clip to banana plug combination, and the red lead is a test probe to banana jack combination.

8.4.2 SINGLE RACK MOUNT KIT (P/N 45410)

The single rack mount kit allows one Model 7004A Digital Multimeter to be installed in a standard 19 inch rack. Two alternate end trims are removed along with the two handles, bail, and foot assembly. The rack mounting panel, adapter end trim, handles, and chassis adapter are then installed. The kit is symmetrical so the unit may be installed in either half of the rack.

8.4.3 DUAL RACK MOUNT KIT (P/N 37492-4-1)

The dual rack mount kit allows two Model 7004A Digital Multimeters to be mounted side-by-side in the same 19 inch rack. Remove the opposite front end trims, both bottom covers, rear end trim, and handles; and add the rack mount, end trim with handles, and two spacers between the two units.

8.4.4 FRONT PANEL SNAP COVER (P/N 37229-4-1)

The protective front panel snap cover is completely assembled and hooks on to the front end trims.

05 OPTION BCD ASSEMBLY PARTS LIST

Ref.	Description	SD Part No.
	05 Option BCD Assembly	37218-4-1
	05 Option BCD Schematic	37218-7-1
J101	Connector, 30 Pin	J0504
J202	Connector, 24 Pin	J0298
P201	Mating Connector	J0244
	Cable Assembly, BCD	37218-3-1

09 OPTION BATTERY PACK P.C. BOARD PARTS LIST

Ref.	Description	SD Part No.
	Battery Pack P.C. Board Assembly	37469-4-1
	Battery Pack P.C. Board Schematic	37469-7-1
C1	Capacitor, .47 µF, 200 V	03284010
C2	Capacitor, .47 µF, 200 V	03284010
C3	Capacitor, 4.7 µF, 25 V	03287470
C4	Capacitor, 1 µF, 25 V	C0879
C5	Capacitor, .01 µF, 500 V, Disc.	C0423
C6	Capacitor, .01 µF, 100 V, Disc.	C0556
CR1	Diode, 1N4005	CR0284
CR2	Diode, 1N4005	CR0284
CR3	Diode, 1N4005	CR0284
CR4	Diode, 1N4005	CR0284
CR5	Diode, 1N4151	CR0150
CR6	Diode, 1N4151	CR0150
CR7	Diode, 1N4005	CR0284
CR8	Diode, 1N4151	CR0150
F3	Fuse, 1.5 A, F Blo, 8AG	F0046
Q1	Transistor, 2N3569	Q0318
Q2	Transistor, 2N3569	Q0318
Q3	Transistor, 2N6103	Q0317
Q4	Transistor, 2N6103	Q0317
Q5	Transistor, 2N3569	Q0318
Q6	Transistor, 2N2219	Q0246
Q7	Transistor, MPS A12	Q0286
Q8	Transistor, 2N4918	Q0268
R1	Resistor, 3.9 k, 5%, 1/4 W	R0939
R2	Resistor, 3.9 k, 5%, 1/4 W	R0939
R3	Resistor, 150 Ω, 5%, 1/4 W	R0983
R4	Resistor, 5.6 k, 5%, 1/4 W	R0821
R5	Resistor, 100 Ω, 5%, 1/4 W	R0966
R6	Resistor, 470 Ω, 5%, 1/4 W	R1044
R7	Resistor, .24 Ω, 5%, 2 W	02394000
R8	Resistor, 470 Ω, 5%, 1/4 W	R1044
R9	Resistor, 5.6 k, 5%, 1/4 W	R0821
R10	Resistor, 100 Ω, 5%, 1/4 W	R0966
R11	Resistor, 10 k, 5%, 1/4 W	R0766
R12	Resistor, 3.3 k, 5%, 1/4 W	R0742
R13	Resistor, 100 k, 5%, 1/4 W	R0741

09 OPTION BATTERY PACK P.C. BOARD PARTS LIST (Cont'd)

Ref.	Description	SD Part No.
R14	Resistor, 2.2 M, 5%, 1/4 W	R1014
R15	Not Used	
R16	Resistor, 1 Ω, 5%, 2 W W	R2855
R17	Resistor, 14.61 k, 1%, 1/4 W	R0859
R18	Resistor, 11.8 k, 1%, 1/4 W	R1003
R19	Resistor, 5 k, Potentiometer	R2697
R20	Resistor, 470 Ω, 5%, 1/4 W	R1044
R21	Resistor, 6.8 k, 5%, 1/4 W	R0696
R22	Resistor, 10 k, 5%, 1/4 W	R0766
R23	Resistor, 1 M, 5%, 1/4 W	R0962
TP1	Test Point, Red	E0279
TP2	Test Point, Black	E0280
U1	Integrated Circuit, SN74L02N	25797
U2	Integrated Circuit, SN74L73N	45200
U3	Integrated Circuit, μ723	25761
VR1	Diode, FZ901 Transistor used as 5.6 V, Zener	26015340
	Heat Sink, (Q8)	H1956
	Receptacle	H2042

09 OPTION BATTERY PACK ASSEMBLY PARTS LIST

Ref.	Description	SD Part No.
	09 Option Battery Pack Assembly	37219-4-1
BT1	Battery, 6 V, 4.5 A. Hr.	BT0005
BT2	Battery, 6 V, 4.5 A. Hr.	BT0005
S202	Switch, 4P3T Slide	S0415
	Battery Switch Assembly	37228-4-1
	Battery Pack P.C. Board Assembly	37469-4-1
	Battery Clamp Assembly	37227-4-1
	Battery Clamp Insulator	37472-1-1
	Battery Clamp	37227-1-1

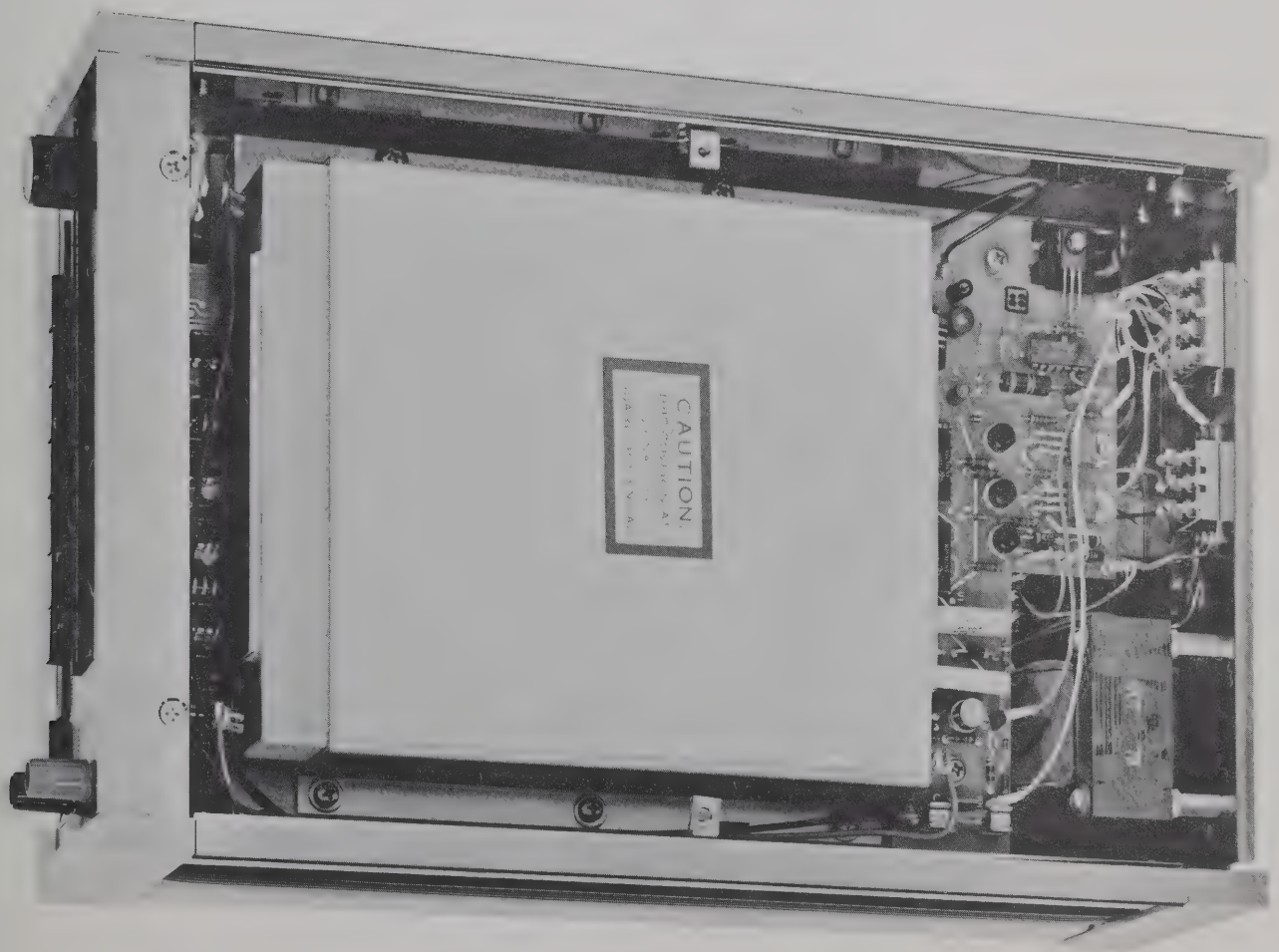


FIGURE 8.1 BATTERY PACK, INSTALLED VIEW

ACCESSORY, INPUT TEST LEADS PARTS LIST

Ref.	Description	SD Part No.
	Input Test Leads	37232-4-1
3	Test Probe Red	E0313
7	Alligator Clip Black	E0311
9	Plug, Banana Red	J0528
11	Plug, Banana Black	J0529
13	Wire, Belden 8899 Red	W0090
15	Wire, Belden 8899 Black	W0089
	Alternate Assembly Complete Red	Pomona 1986-36
	Alternate Assembly Complete Black	Pomona 1959-36

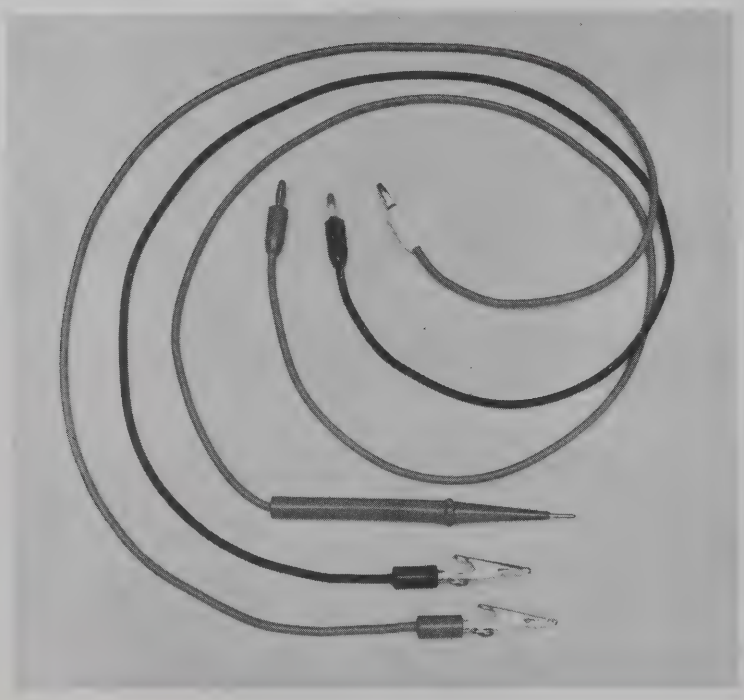


FIGURE 8.2 INPUT TEST LEADS
(White bannana plug to aligator clip optional.)

ACCESSORY, SINGLE RACK MOUNT KIT PARTS LIST

Ref.	Description	SD Part No.
	Assembly/Installation Dwg 3 1/2" Half Rack Mtg.	45410
	DELETIONS	
	End Trim	33693
	Handle	33570-1
	Bail & Foot Assembly	H1927
	ADDITIONS	
7	End Trim, Rack Mnt	45476-2
8	Handle	H1847
10	Rack Mtg Panel	39953-2
11	Rack Mtg Panel Adapter	39954-2
12	Chassis Adapter	45411-1

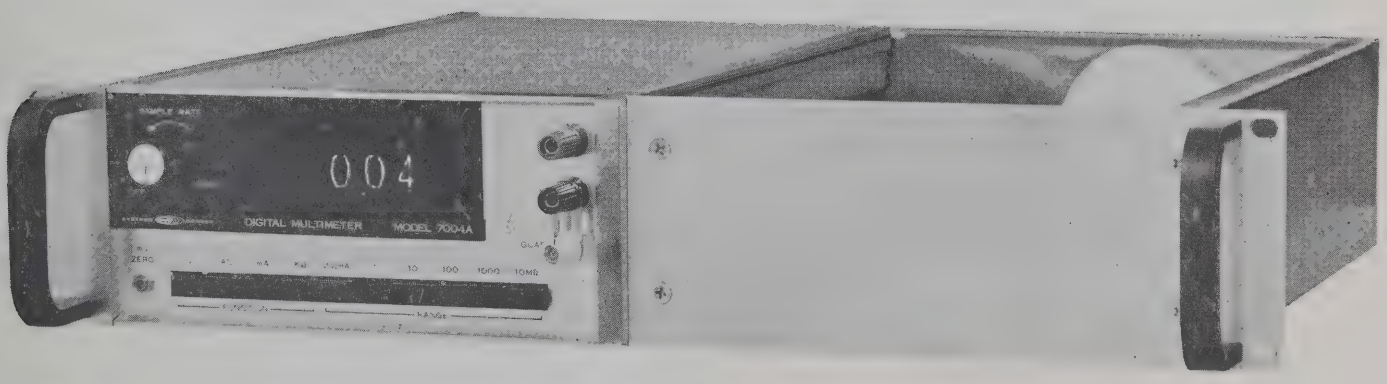


FIGURE 8.3 SINGLE RACK MOUNT KIT

ACCESSORY, DUAL RACK MOUNT KIT PARTS LIST

Ref.	Description	SD Part No.
	Final Assembly Dual Rack Mount	37492-4-1
	Final Assembly	37190-4-1
	DELETE FROM 37190-4-1	
	Bottom Cover Assembly	45065-3
	End Trim (2 From Rear)	39033
	(2 From Outside Front)	
	Handle	33570-3
	ADD TO 37190-4-1	
7	Bottom Cover	45083-3
9	Spacer 6-32 x 5/8	E0109
10	Spacer, 6-32 x 3/4	H1939
15	End Trim Rack Mounting	45476-2
16	Handle	H1847

ACCESSORY, FRONT PANEL SNAP COVER PARTS LIST

Ref.	Description	SD Part No.
	Front Cover Assembly	37229-4-1
3	Cover Front	37229-1-1
4	Cover Drawn	H2021
7	Cover Stop	39411
9	Latch Mod	39099
11	Cover Hook	45173
15	Rubber U Channel	H0207
	Latch	H1947

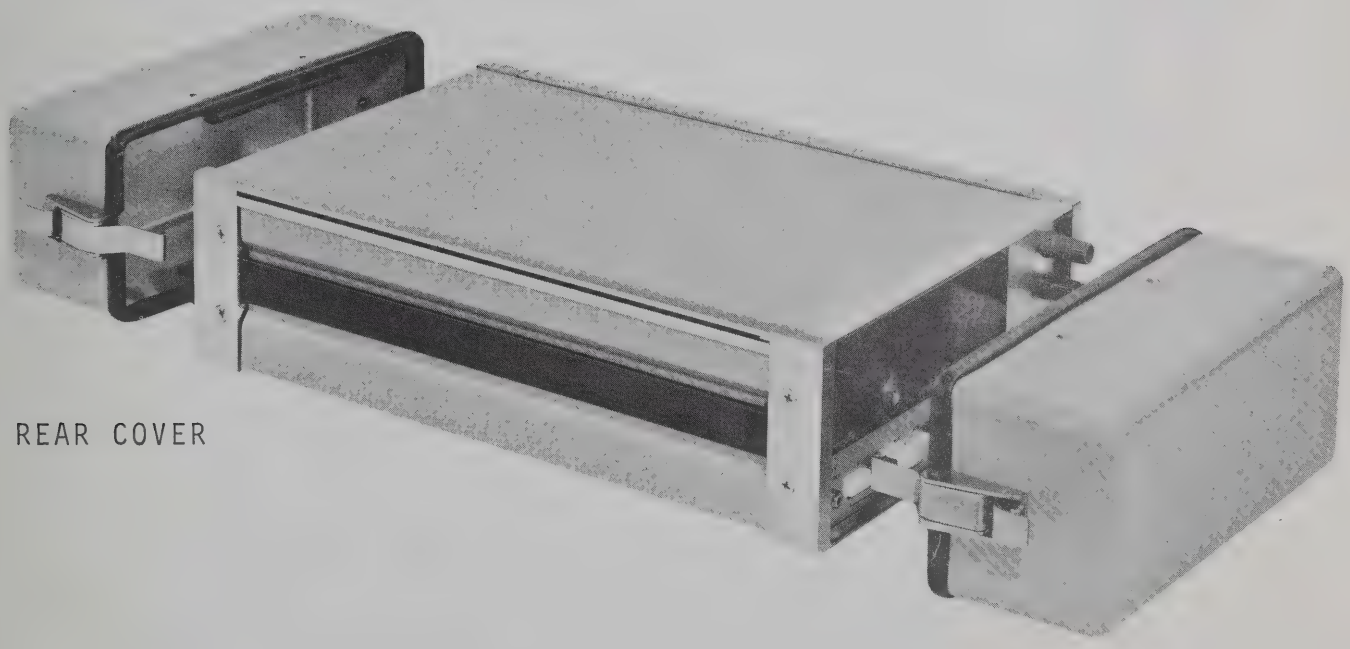
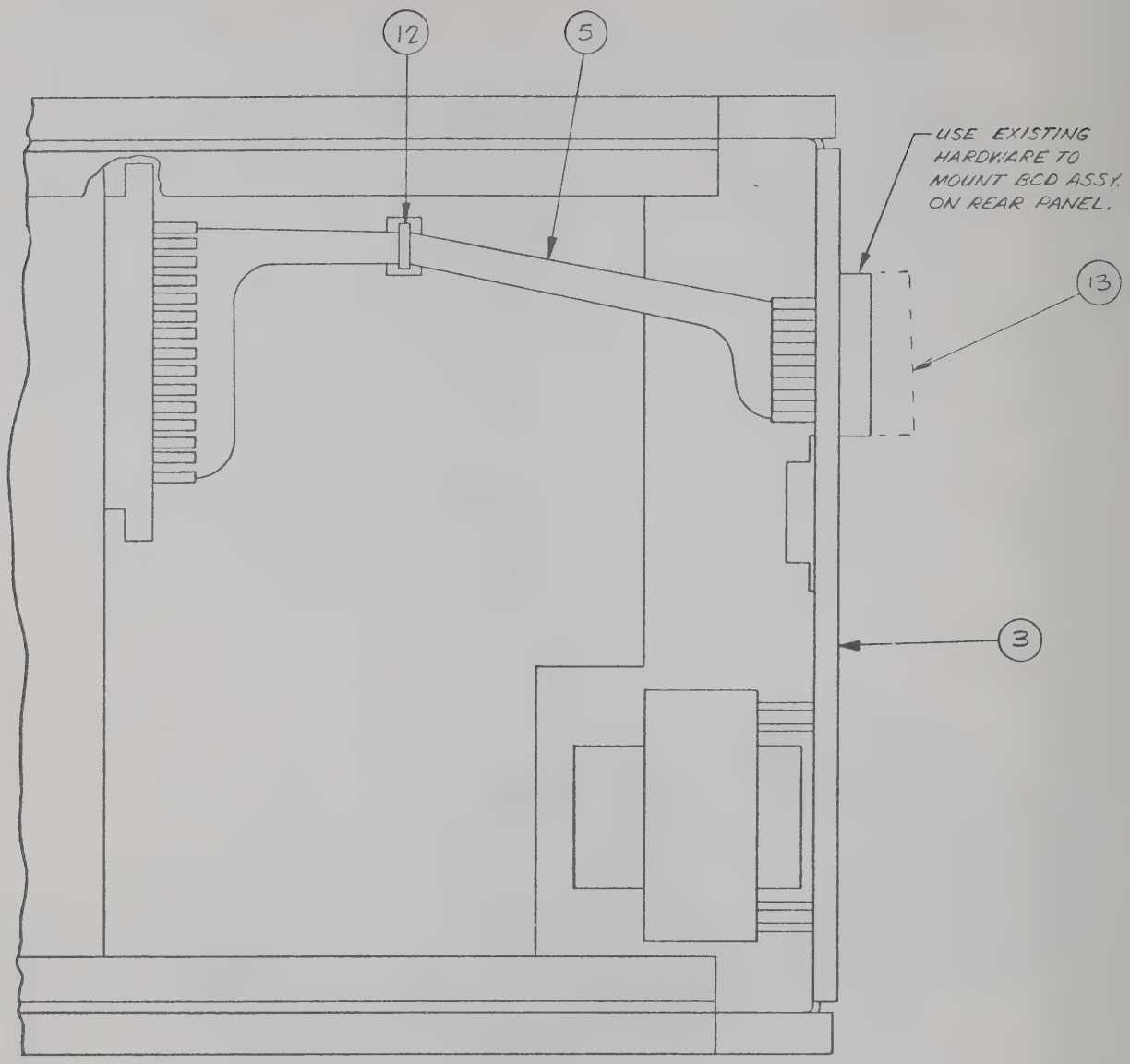


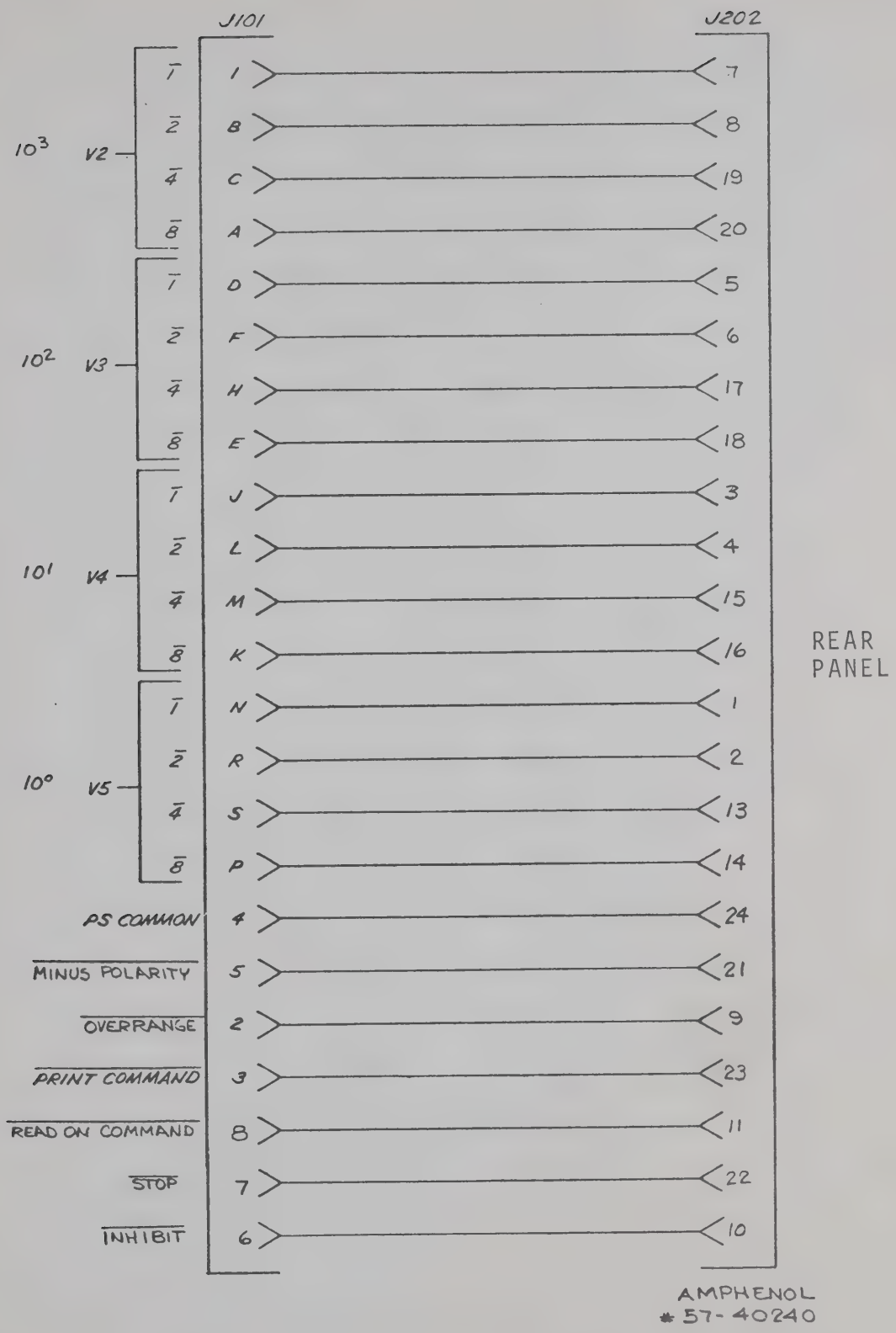
FIGURE 8.4 FRONT AND REAR PANEL SNAP COVER



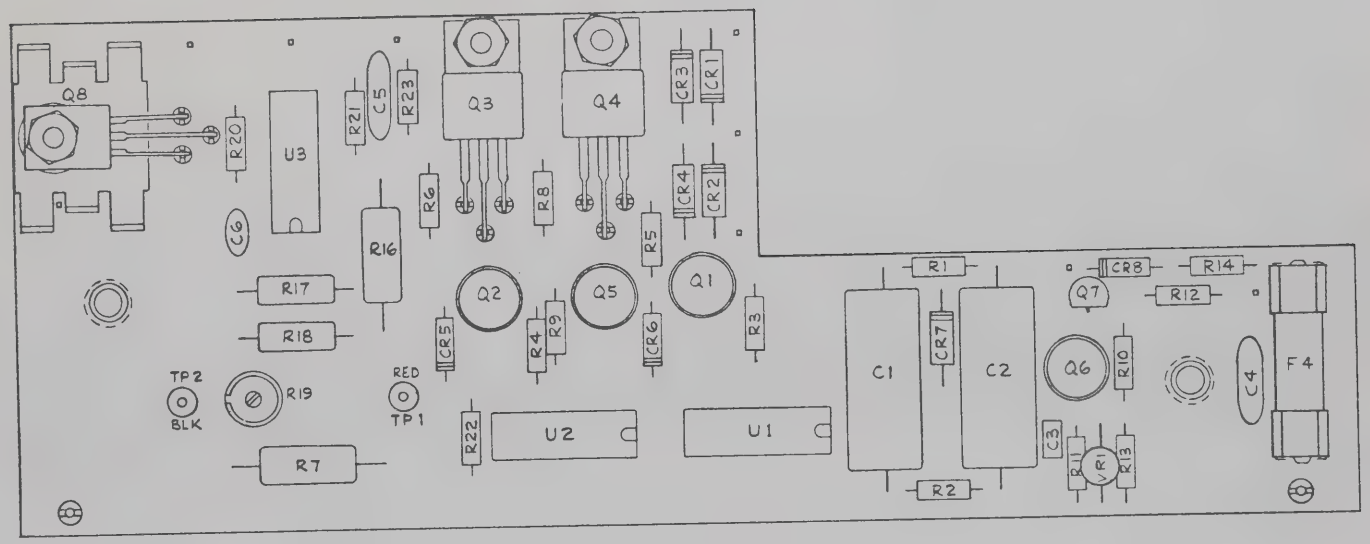
NOTES:

1. REMOVE BCD COVER PLATE ON REAR PANEL.
2. REMOVE UNIT TOP COVER, TOP GUARD COVER & BATTERY PACK IF INSTALLED.
3. LIFT UP READOUT BD. AND CONNECT BCD CABLE AS SHOWN.
4. CUT OLD PLASTIC TIE & TIE CABLE TO ANCHOR USING NEW PLASTIC TIE.
5. ADD -05 TO UNIT LABEL ON REAR PANEL.

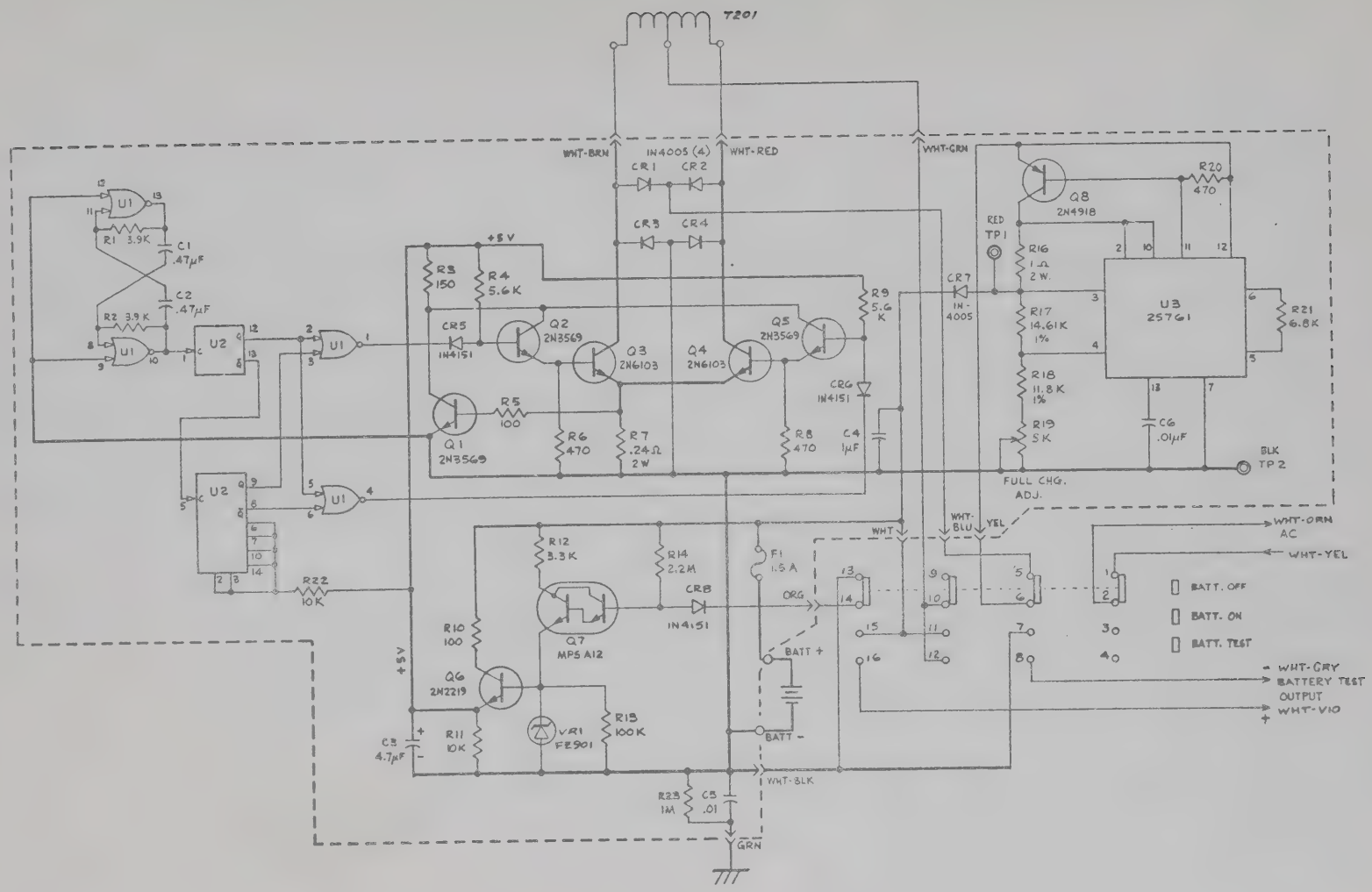
OPTION 05, BCD ASSEMBLY #37218-4-1A



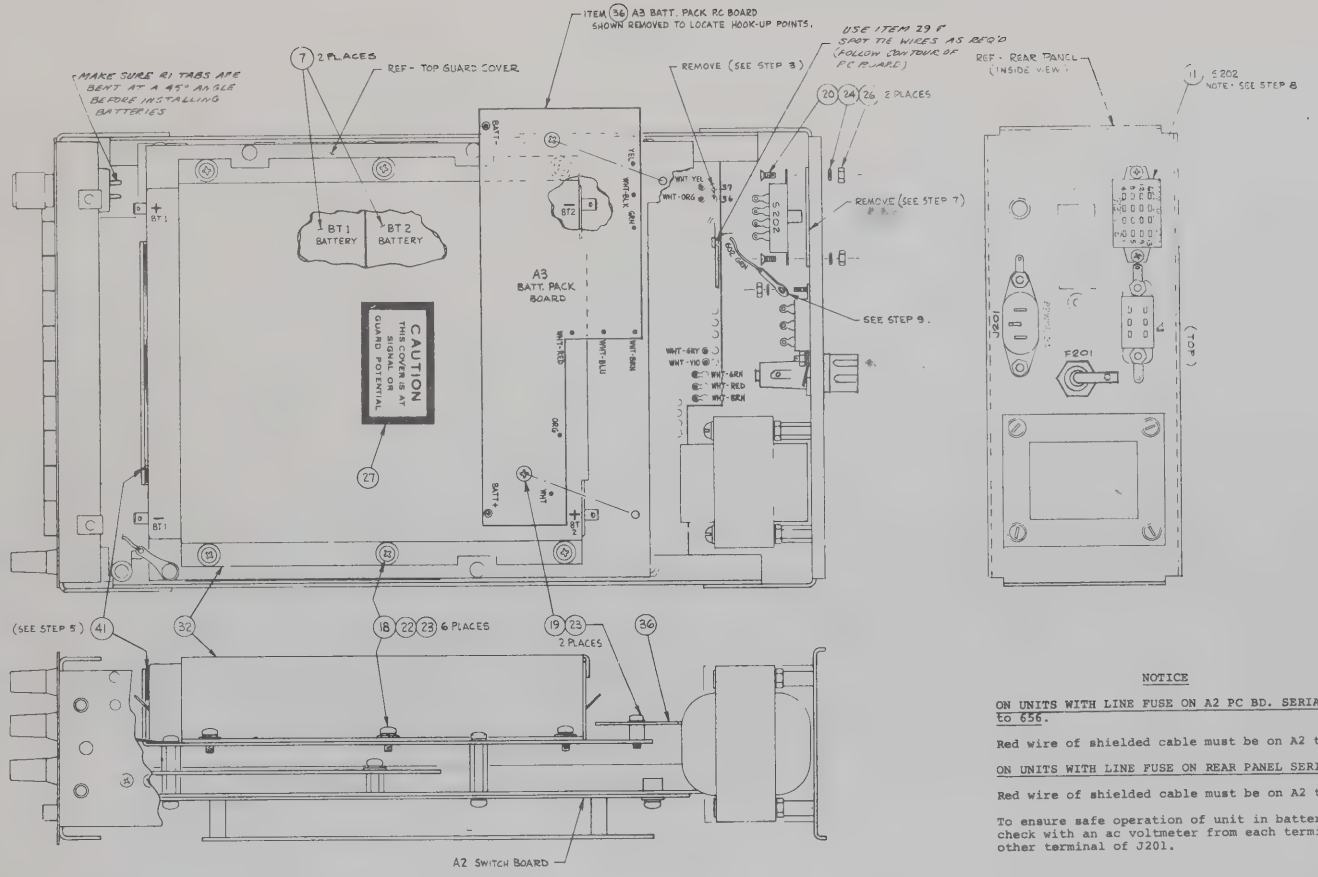
OPTION 05, BCD SCHEMATIC #37218-7-1A



OPTION 09, A3, BATTERY PACK P.C. ASSEMBLY #37469-4-1B



OPTION 09, A3, BATTERY PACK SCHEMATIC #37469-7-1A


ITEM (36) A3 BATT. PACK PC BOARD SHOWN REMOVED TO LOCATE HOOK-UP POINTS.
USE ITEM 29 & SPOT TIE WIRES AS REQ'D (FOLLOW CONTOUR OF PC BOARD)
REF - REAR PANEL (INSIDE VIEW)
(11) S202 NOTE - SEE STEP 8
(7) 2 PLACES
REF - TOP GUARD COVER
MAKE SURE RI TABS ARE BENT AT A 45° ANGLE BEFORE INSTALLING BATTERIES
REMOVE (SEE STEP 3)
(20) (24) (26) 2 PLACES
REMOVE (SEE STEP 7)
SEE STEP 9.
BT1 BATTERY
BT2 BATTERY
A3 BATT. PACK BOARD
CAUTION THIS COVER IS AT SIGNAL OR GUARD POTENTIAL
J201
F201
(27)
(SEE STEP 5) (41)
(32)
(18) (22) (23) 6 PLACES
(19) (23) 2 PLACES
(36)
A2 SWITCH BOARD

NOTES :

1. A MODEL 7004 IS SHOWN WITHOUT COVERS, AC LINE CORD, AND A SECTIONAL SIDE VIEW; ONLY REQUIRED DETAILS ARE SHOWN.

NOTICE

ON UNITS WITH LINE FUSE ON A2 PC BD. SERIAL #101 to 656.

Red wire of shielded cable must be on A2 terminal 36.

ON UNITS WITH LINE FUSE ON REAR PANEL SERIAL #657 ON.

Red wire of shielded cable must be on A2 terminal 37.

To ensure safe operation of unit in battery mode, check with an ac voltmeter from each terminal to the other terminal of J201.

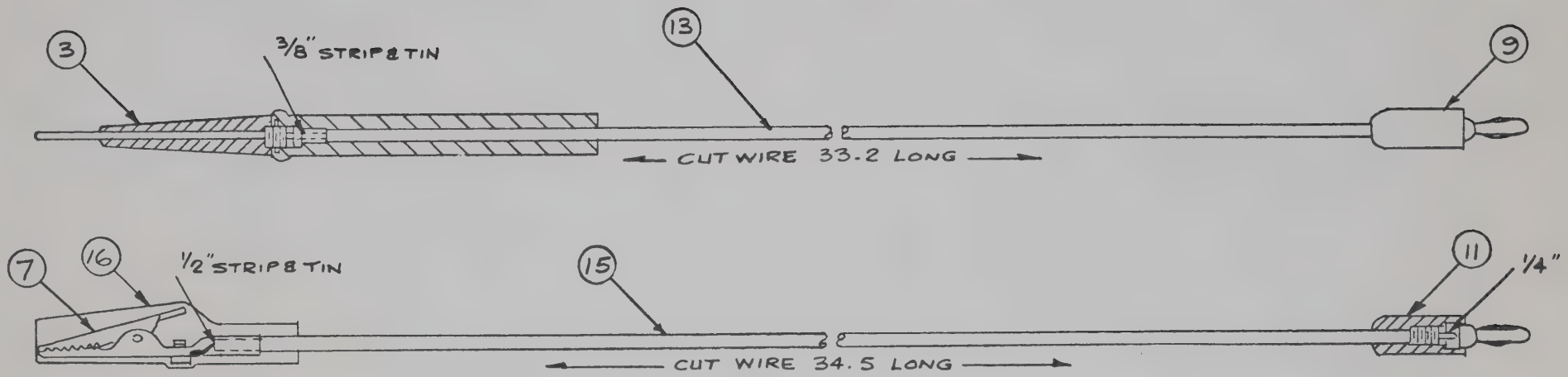
BATTERY PACK HOOKUP

WIRE No	COLOR	FROM	TO
701	WHT-YEL	S202 - 1	A2 WHT-YEL
702	WHT-ORG	- 2	A2 WHT-ORG
703	WHT-BLU	- 5	A3 WHT-BLU
704	YEL	- 6	A3 YEL
705	WHT-GRN	- 10	A2 WHT-GRN
706	WHT-BLK	- 3	A3 WHT-BLK
707	ORG	- 14	A3 ORG
708	WHT	- 15	A3 WHT
709	WHT-VIO	- 16	A2 WHT-VIO
710	WHT-GRY	- 8	A2 WHT-GRY
601	BLU	BT1 -	BT2 +
602	GRN	A3 - GRN	CHASSIS GROUND
603	WHT-BRN	A3 WHT-BRN	A2 WHT-BRN
604	WHT-RED	A3 WHT-RED	A2 WHT-RED
508	BLK	A3-BATT -	BT2 -
504	RED	A3-BATT+	BT1 - +

INSTALLATION PROCEDURE

1. REMOVE THE AC LINE CORD.
2. REMOVE THE TOP AND BOTTOM UNIT COVERS.
3. REMOVE JUMPER WIRE BETWEEN TERMINALS NO. 36 & 37 ON A2 SWITCH BOARD. SEE NOTICE.
4. RE-INSTALL THE BOTTOM UNIT COVER.
5. APPLY ITEM 41, FOAM TAPE; BEHIND AND ALONG TOP FLANGE OF THE TOP GUARD COVER.
6. POSITION BATTERIES BT1 & BT2 ON THE TOP GUARD COVER; BOTH + & - TABS ON EACH BATTERY. SECURE THE BATTERIES IN PLACE AND BACK-TO-BACK WITH THE BATTERY CLAMP ASSEMBLY, ITEM NO. 32.
7. REMOVE SWITCH PLATE ON THE REAR PANEL.
8. INSTALL SWITCH (S202) ASSEMBLY, ITEM NO.11 ON THE REAR PANEL. SWITCH MUST BE MOUNTED WITH THE WHT-YEL WIRE AT LUG #1. SEE REAR PANEL VIEW. SET SWITCH TO "OFF".
9. REMOVE NUT AND WASHER OF THE "LINE" SWITCH AND INSTALL THE GROUND LUG OF WIRE NO. 602 (GRN). BEND LUG AS REQUIRED.
10. CONNECT ALL WIRE ENDS WHICH GO TO A2 SWITCH BOARD. SEE HOOK-UP TABLE ABOVE.
11. REMOVE THE 1.5 AMP. FUSE (F4) ON THE BATTERY PACK P.C. ASSEMBLY A3, ITEM NO. 36. SET THIS FUSE ASIDE.
12. MOUNT THE BATTERY PACK P.C. BOARD ASSEMBLY A3 ON THE TOP GUARD COVER AS INDICATED.
13. HOOK UP THE REMAINING TERMINATIONS PER THE ABOVE TABLE.
14. RE-INSTALL THE 1.5A FUSE ON THE BATTERY PACK P.C. BOARD ASSEMBLY A3. IN HOUSE UNITS (SYSTRON DONNER) INSTALL AT TEST. SEE NOTICE.
15. APPLY THE "CAUTION" LABEL, ITEM NO. 27 AS SHOWN.
16. RE-INSTALL THE TOP COVER ON THE UNIT.
17. MARK THE IDENTIFICATION LABEL ON THE REAR PANEL AS MODEL "7004-09 OPT.".
18. RE-INSTALL THE AC LINE CORD.

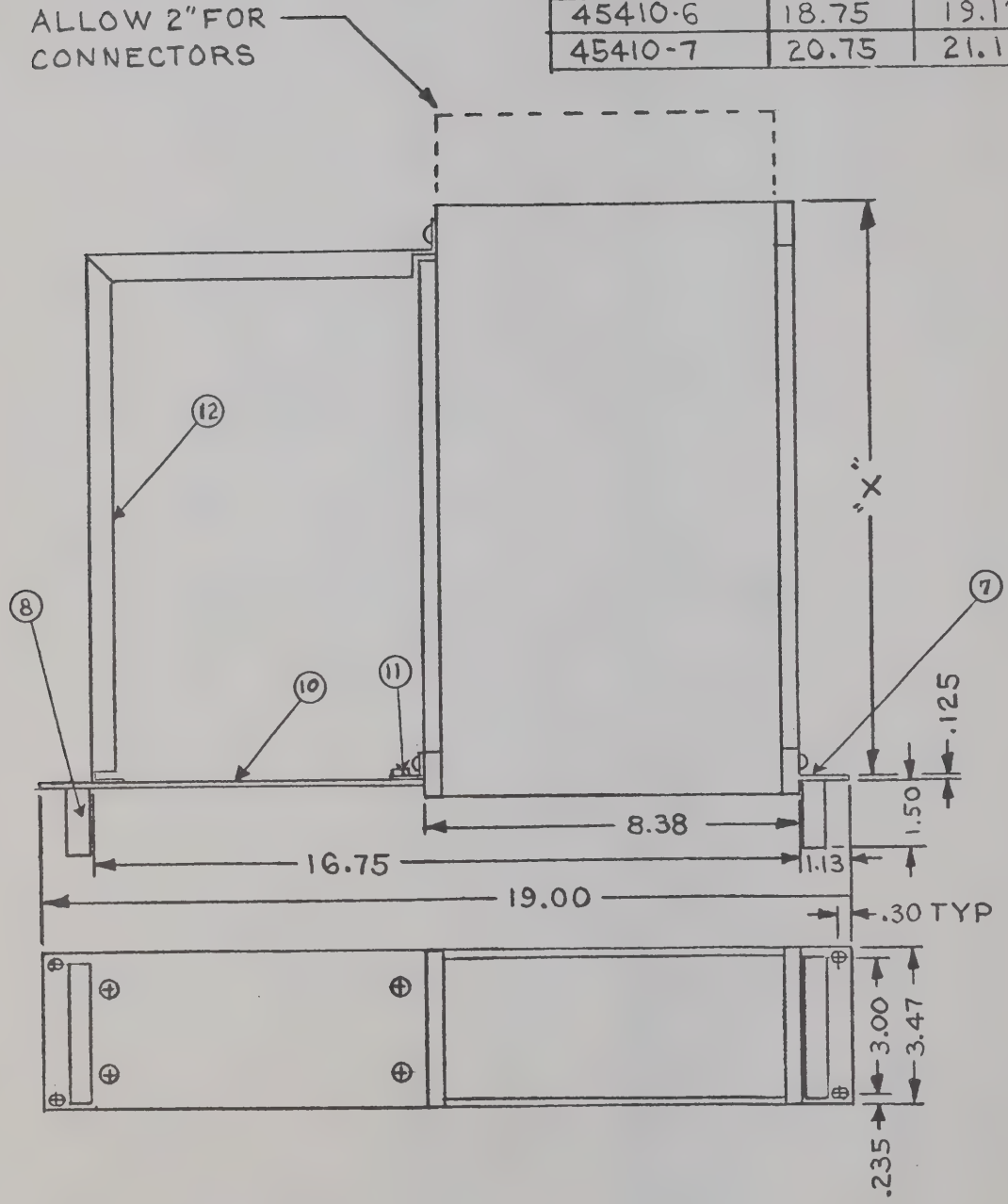
OPTION 09, BATTERY PACK ASSEMBLY #37219-4-1B



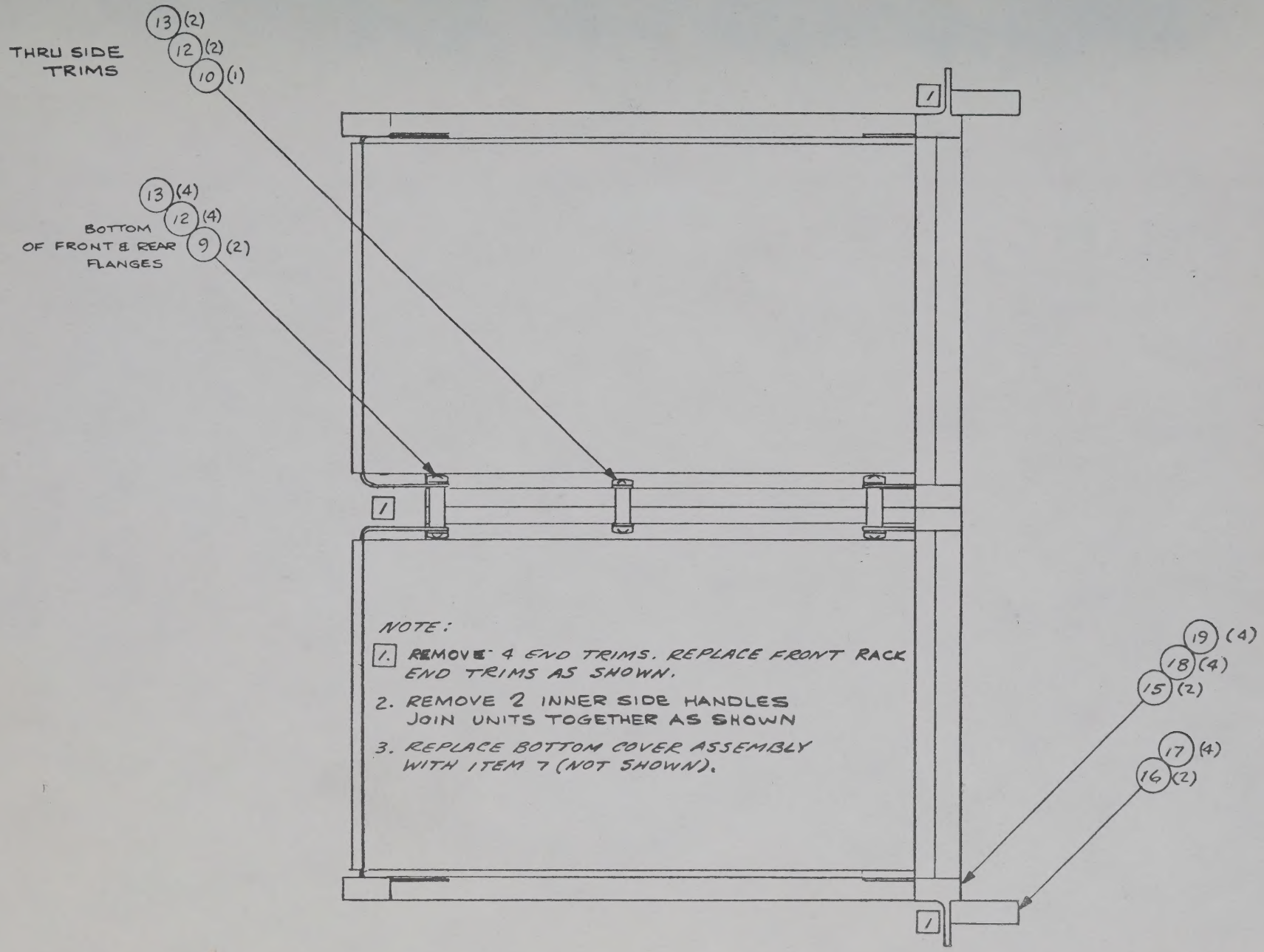
ALTERNATE POMONA MODEL 1959-36 BLACK
1986-36 RED

ACCESSORY, INPUT TEST LEADS #37232-4-1B

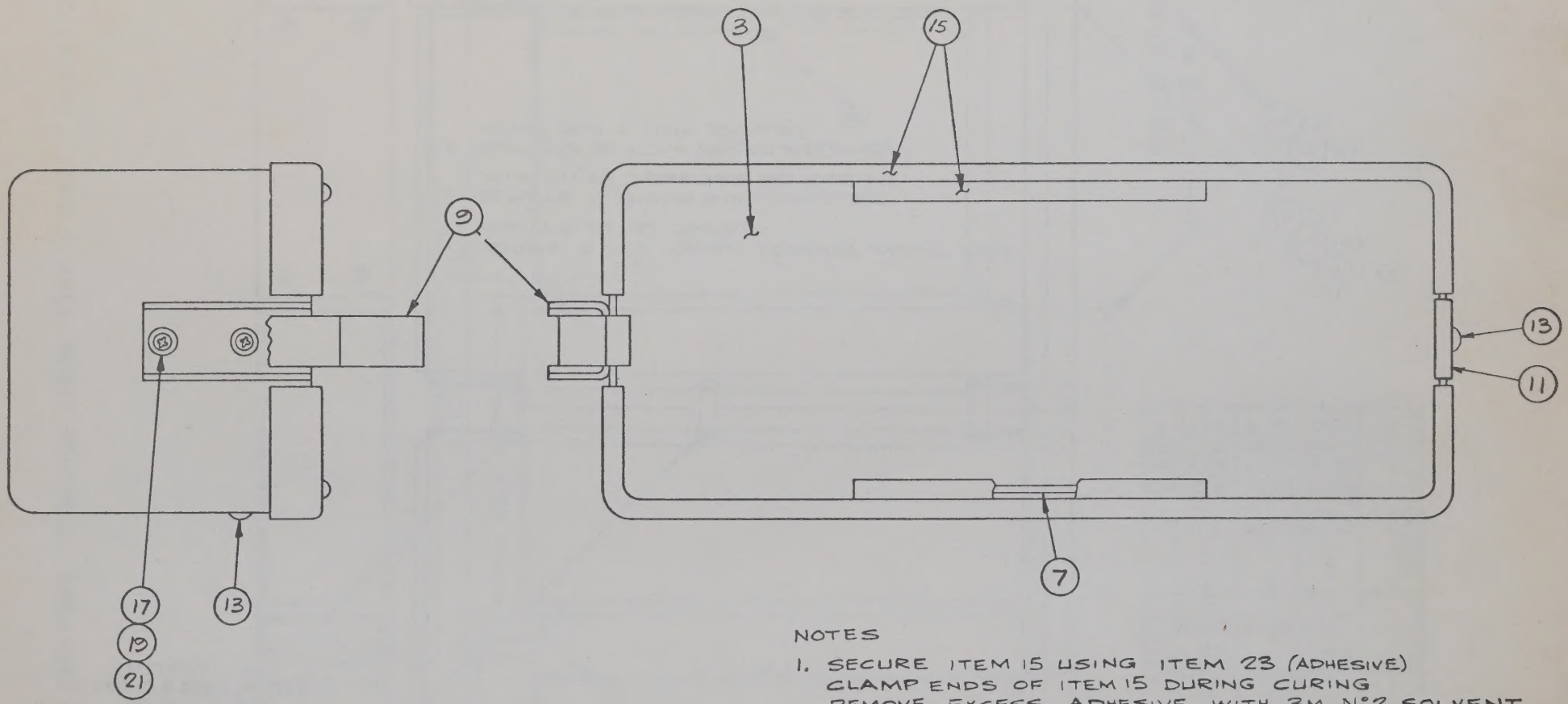
TABULATION		
P/L Nº	"X"	INSTR DEPTH
45410-1	8.75	9.12
45410-2	10.75	11.12
45410-3	12.75	13.12
45410-4	14.75	15.12
45410-5	16.75	17.12
45410-6	18.75	19.12
45410-7	20.75	21.12



ACCESSORY, SINGLE RACK MOUNT ASSEMBLY #45410A



ACCESSORY, DUAL RACK MOUNT ASSEMBLY #37492-4-1A



NOTES

1. SECURE ITEM 15 USING ITEM 23 (ADHESIVE) CLAMP ENDS OF ITEM 15 DURING CURING REMOVE EXCESS ADHESIVE WITH 3M N°2 SOLVENT.

WARNING.

ADHESIVE & SOLVENT MUST ONLY BE USED IN A WELL VENTILATED AREA.

ACCESSORY, FRONT PANEL SNAP COVER ASSEMBLY #37229-4-1A

FUNCTION V
INPUT ± 1000V

RANGE	+	−
1000		
100		
10		
1		
.1		

FUNCTION V & AC
INPUT 500V at 1KHz

RANGE	
1000	
100	
10	

FUNCTION V & AC
INPUT 130V at 1KHz

RANGE	
1	
.1	

FUNCTION KΩ

INPUT	RANGE	+	−
± 1.00Ω	1000		
± 1.50Ω	1000		
± 1.00Ω	100		
± 130Ω	10		
± 35Ω	1		

FUNCTION mA
INPUT ± 1.2A

RANGE	+	−
1000		

LINE VOLTAGE

INPUT	+12V	−12V	+5	+200V
103				
115				
127				
SWITCH AT 230V				
230				

FUNCTION V
RANGE .1

INPUT	LIMIT	+	−
.00000	± 2		
.05000	± 2		
.09100	± 2		
.10000	± 2		
.13000	± 4		

RANGE 1

0.0000	± 1		
0.5000	± 1		
1.3000	± 2		

RANGE 10

00.000	± 1		
05.000	± 1		
13.000	± 2		

RANGE 100

000.00	± 1		
050.00	± 1		
130.00	± 2		

RANGE 1000

0000.0	± 1		
0500.0	± 1		
1000.0	± 2		

FUNCTION V & AC

RANGE	LIMIT
.1	< 20
1	< 2
10	< 2
100	< 2
1000	< 2

RANGE 1 f = 200Hz

INPUT	LIMIT
0.0000	< 2
0.0010	< 2
0.0100	< 2
0.1000	< 4
1.0000	< 22
1.3000	< 28

RANGE .1
INPUT 100mV

FREQ	LIMIT
50	< 40
200	
1K	
5K	
10K	
20K	

RANGE 1
INPUT 1V

FREQ	LIMIT
50	< 22
1K	
20K	

RANGE 10
INPUT 10V

FREQ	LIMIT
50	< 22
1K	
20K	

RANGE 100
INPUT 100V

FREQ	LIMIT
50	< 22
1K	
20K	

RANGE 1000
INPUT 500V

FREQ.	LIMIT
50	< 12
1K	
10K	

FUNCTION KΩ
RANGE 1

INPUT	LIMIT	
0.0000	< 1	
0.5000	< 6	
1.3000	< 14	

RANGE 10

00.000	< 1	
05.000	< 6	
13.000	< 14	

RANGE 100

000.00	< 1	
050.00	< 6	
130.00	< 14	

RANGE 1000

0000.0	< 1	
0500.0	< 6	
1300.0	< 14	

RANGE 10M

00.000	< 1	
05.000	< 6	
13.000	< 14	

☑ COMMON MODE ISOLATION - 500VDC

☐ OS OPTION

☑ OS OPTION
- a. CHARGE RATE 13.75 ± .05V
- b. AC SHORT REMOVED
- c. CHARGE LEVEL > 12V

DC CURRENT
FUNCTION mA
RANGE .1

INPUT	LIMIT	+	−
.00000	± 4		
.05000	± 9		
.10000	± 14		
.13000	± 17		

RANGE 1

0.0050	± 1		
1.3000	± 14		

RANGE 10

00.050	± 1		
13.000	± 14		

RANGE 100

000.00	± 1		
130.00	± 14		

RANGE 1000

0000.0	± 1		
1300.0	± 14		

L10-234

SERIAL Nº 1944

TESTED BY [illegible]

DATE 9-15-73